TENDER DOCUMENT

NIT No. : DLI/C&E/731/001

FOR

Tender for ‘Construction of Nurses Hostel & 04 BHK Building for Teaching Hospital and Medical College at Sundergarh Odisha’.

VOLUME – II

Tender Specifications (GTS)

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(A GOVT. OF INDIA ENTERPRISE)
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CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGARH, ORISSA

TECHNICAL SPECIFICATION & LIST OF MAKE

CLIENT:

CONSULTANTS:
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Special Consultant
Architect Hafeez Contractor
TECHNICAL SPECIFICATIONS
CIVIL WORK
SPECIFICATIONS

1. SPECIFICATIONS FOR EXCAVATION AND EARTHWORK

1.1 SCOPE
The scope of work broadly includes but is not necessarily limited to the following, i.e., clearing of the site, excavation of foundation trenches, back-filling, disposal of surplus earth as required including dewatering, shoring and strutting. Contractor shall provide all tools, labour, equipment and incidentals necessary, required for completion of all aspects of work covered in these specifications.

1.2 TYPES OF SOIL
Contractor shall thoroughly acquaint himself with the types of soil in excavation by an inspection of nature of the ground at site.

1.3 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 road, drains, sheds, etc. should be cleared and all obstructions, loose stones, materials, and rubbish of all kinds, stump, brush wood and trees removed as directed, roots being entirely grubbed up. All useful materials obtained will not be the property of the contractor and will be handed over. Rejected materials will be removed by the contractor to his own dump.

1.4 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 EIC and a proper record of these levels to be kept, which shall be jointly signed by the Contractor and the EIC. A block level plan showing all the ground levels of the plot shall be prepared and shall jointly be signed by the contractor and the Engineer-in-charge.

1.5 SETTING OUT
After clearing the site, and preparing the site level plan, the Contractor will set out the center lines of the building or other involved works and get the same approved. It shall be the responsibility of the Contractor to install substantial reference marks; bench marks etc. and maintain them as long as required. The Contractor will assume full responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

1.6 EXCAVATION AND PREPARATION OF FOUNDATIONS FOR CONCRETING

1.6.1 GENERAL
Foundation trenches shall be dug wet or dry to the dimensions as shown on the drawings or as directed. The excavated materials 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 2 m from the ground.

The contractor shall, at his expense and without any extra charge, make provision for all shoring and strutting, Extra excavation in slope, extra excavation in working space, dredging or bailing out water, 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. Cost of such extra excavation and the filling required therein as specified above shall be borne in full by the contractor.

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. NO extra charges shall be admissible on this account.
The bottoms of all excavation shall be trimmed and leveled in accordance with drawings / directions. The bottoms of all excavation shall be rammed and wetted before deposition of concrete. The contractors shall report / Engineer-in-charge when the excavation is ready to receive concrete. NO concrete shall be placed in foundations until the contractor has obtained the approval of Engineer-in-charge.

1.6.2 PROTECTION

All foundation trenches and similar excavations shall be strong, fenced and marked with red lights at night for watchmen to avoid accidents.

Adequate protective measures shall be taken to see that the excavation does not affect or damage adjoining structures. All measures required for the safety of the excavation, the people working in and near the foundation trenches, property and the people in the vicinity shall be taken can by the Contractor at his own cost, being entirely responsible for any injury and damage to property caused by his negligence or accident due to his construction operations.

1.6.3 STACKING OF EXCAVATED MATERIALS:

Work for excavation shall include sorting out of useful materials and stacking them on site as directed. Materials suitable and useful for back-filling, plinth, filling, leveling of the plot or other use shall be stacked convenient places, but not in such a way as to obstruct free movement of men, equipment and vehicles or encroach on the area required for constructional purposes.

1.7 BACKFILLING

1.7.1 Earth obtained from excavation (or approved earth brought from out side for which no extra payment shall be made) shall be filled in layers as described in 1.7.3 around the foundations and under floors. In case extra earth used for filling is required under floors, plinth protection including sit outs, courtyards, the contractor will do at their own cost. The lump sum offer shall be deemed to include the earth filling required under floors and plinth protection with plinth height shown in Drawing above the bottom of foundation concrete and finished courtyard level shown in Drawing below D PC /coping level of the main building.

1.7.2 QUALITY OF FILL

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. Fine sand for filling is River Sand. Black cotton soil shall not be used for back filling or plinth filling.

1.7.3 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. An optimum system of compaction. The fill material shall be pulverized before depositing in place. Optimum moisture content shall be maintained for the filled 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 throughout, the material shall be dumped in place in approximately horizontal layers “Edge dumping”, a process by which the materials 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 load shall be maintained and also care shall be taken to prevent any wedging action.

1.8 DE-WATERING

Work for excavation shall include bailing or pumping out water which may accumulate in the excavation during the progress of work either form subsoil, seepage, springs, 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 of any adjacent structure. When water is met with in foundation trenches, pumping out water shall be from an auxiliary pit of adequate size dug slightly outside the building excavations. The depth of the auxiliary pit shall be more than the working foundation trench levels. The auxiliary pit shall be refilled with approved excavated materials after the de-watering is over.

The excavation shall be kept free from water –

1. When Concrete/Reinforcement work/water proofing work is in the progress.
2. Till the EIC consider that concrete/mortar is sufficiently set.

1.9 SURPLUS EXCAVATED MATERIAL

All excavated material certified as surplus and not useful, shall be removed by the Contractor from the site in an approved manner at his own cost and risk so as indemnify owner from any claims any time of whatsoever nature.

2. SPECIFICATIONS FOR ANTI-TERMITE TREATMENT

2.1 GENERAL

Prevention of termite from reaching the super structure can be 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 surface of wall, and filling of each under floors and treating the surface at ground level 900 mm around the building.

2.2 MATERIAL

Anti termite treatment, shall be carried out strictly in accordance with CPWD specifications using Chlorophyrifos (CPP) an Emulsified concentrate @ 1% concentration or any other approved chemical.

2.3 PRE-CONSTRUCTION CHEMICAL TREATMENT

This is a process in which chemical treatment is 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 specified quantity of chemical is used for the required areas during the operation.

2.4 TIME OF APPLICATION

Soil treatment shall start when foundation trenches and pits are ready to take lean concrete in foundations. Lying of lean concrete shall start when 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 DISTURBANCE

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.
2.6 TREATMENT OF COLUMN PITS AND WALL TRENCHES
a) The bottom surface and the sides (up to a height of above 300 mm) of the excavation made for column pits and trenches shall be treated with the chemical at the rate specified in IS 6313 part II of 2001 or the latest edition.
b) After the column foundation and the wall foundation come up, the back fill in immediate contact with the foundation structure shall be treated at the rate specified in IS 6313 PART OF 2001 or the latest edition of the vertical surface of the substructure 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 prodding the earth at 150 mm centers close to the wall surface and spraying the chemical with the above dose. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete to masonry surface of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.
c) In the case of R.C.C. framed structure with columns and plinth beams and R.C.C basement with concrete, mix is rich and dense (being 1:2:4 or richer), it is unnecessary to start the treatment from the bottom of excavation for columns and plinth beams. The treatment shall start at the depth of 500 mm below ground level. From this depth the back-fill around the columns, beams and R.C.C. basement wall shall be treated at the rate as per IS 6313 Part II of 2001 or the latest edition. The other details of treatment shall be as laid down in the Clause (b) above.

2.7 TREATMENT OF TOP SURFACE OF PLINTH FILLING
The top surface of the filled earth within plinth wall shall be treated with chemical emulsion at the rate as per IS 6313 Part II 2001 or the latest direction (surface area) before the sand/sub-grade is laid. Holes up to 50 to 70 mm deep at 150 mm centers both ways shall be made with crow bars on the surface to facilitate saturation of the soil with chemical emulsion.

2.8 TREATMENT OF JUNCTION OF WALL AND FLOOR
To achieve continuity of the vertical chemical barrier on inner wall surface from the ground level, small channel 30 X 30 mm 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 150 mm 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.

2.9 TREATMENT OF SOIL ALONG EXTERNAL PERIMETER OF BUILDING
During progress of work, provide hole in the soil with iron rods along the external perimeter of the building at intervals of about 150 mm and depth 300 mm 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.

2.10 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.

2.11 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 pipe, or conduit for a distance of 150 mm and up to depth of 75 mm 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 75 mm for distance of over 300 mm from ground level.

2.12 SAFETY PRECAUTIONS
All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapors or spray mists or swallowed.
Person using or handling these chemicals should be warned of these dangers and advised that absorption through the skin in 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.

Special 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 or 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 applications and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed nearby during the mixing. Care should be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs which serve as source of drinking water.

2.13 GUARANTEE

The contractor shall guarantee through a guarantee bond, the anti-termite work for 10 years from the date of completion of the project, and shall indemnify the Engineer-in-charge against any defects that arise therein during the guarantee period as aforesaid. They shall immediately rectify any defects that may occur therein, and repair all other damage occurring to any part of the structure on account of defect in Anti-termite treatment, during the guarantee period of aforesaid.

3. SPECIFICATION FOR CAST – IN – SITU REINFORCED CEMENT CONCRETE

3.1 GENERAL

3.1.1 DESCRIPTION

This section covers the requirements for finishing of cement concrete, proportioning, batching, mixing, testing, placing, compacting, finishing, jointing, curing and all other work as required for cast in place reinforced concrete. The contractor shall provide all the materials including cement, steel, labour, equipment, ‘form work’, scaffolding etc., required for completion of all reinforced concrete works as per drawings and documents. Cement concrete shall be composed of cement, fine aggregate, coarse aggregate, water, with or without admixture as approved, proportioned and mixed as specified herein.

3.1.2 RELATED WORK SPECIFIED ELSEWHERE

a) Steel reinforcement
b) Form work

3.1.3 APPLICABLE CODES AND STANDARDS

The codes and standards generally applicable to the work of this section are listed hereinafter.

IS 383 Coarse and fine aggregates from natural sources for concrete
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 Performed fillers for expansion joints in concrete non-extruding and resilient type
IS 1946 Code of practice for use of fixing devices in walls, Ceiling and floors of solid Construction
IS 2389 Methods of testing of aggregate for concrete’s
IS 2505 Concrete vibrators, immersion type
IS 2645 Integral cement water proofing compounds
IS 3414 Code of practice for design and installation of joints in buildings
IS 3558 Code of practice for use for immersion vibrators for consolidating concrete
IS 4082 Recommendation on stacking and storage of construction materials at
IS 7861 Code of practice for extreme weather concretizing
IS 7861 Recommended practice for hot weather (part I) concretizing
IS 8112 Ordinary Portland Cement grade 43
IS 12269 Ordinary Portland Cement grade 53

PART — I

The following clauses are intended to amplify the requirements of the reference document listed above and the contractor shall comply with these clauses

3.2 SUBMITTALS

3.2.1 Material Report

3.2.2 Prior to start of delivery of materials required, the following shall be submitted by the contractor to the Engineer-in-charge for approval.

Suppliers and / or sources of all consumable materials including cement, steel, fine and coarse aggregates, water additives, bricks and timber etc.

Quality Inspection Plan to ensure continuing quality control of ingredients by periodic sampling, testing and reporting of the quality of materials being supplied.

3.3 PLANT AND EQUIPMENT

The contractor shall submit the following well in advance.

The proposed program, methods and details of plant and Equipment for be used to testing of ingredients and concrete samples.

The proposed programme methods and details of plant & equipment to be used for concrete work.

3.4 REPORTS FOR INSPECTION AND TESTING

During concreting operations, the contractor shall conduct inspection and testing as described under the list of mandatory tests in this volume and all reports thereon shall be submitted in summary form.

3.5 SCHEDULES

Before commencement of the work the contractor shall prepare working schedules of concreting giving dates and rate of pour for each item of work and submit the same for approval.

3.6 MATERIALS

Before bringing to the site, all materials for cement concrete shall be approved. All approved samples shall be deposited in the office of the Engineer-in-charge before placing orders for the materials with suppliers The materials brought on to the work shall conform in every respect to their approved samples.

Fresh samples shall be deposited 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 specification or approved samples. Any of the materials can be tested to find whether they are in accordance with specifications at the contractor’s expense. All bills vouchers and test certificates which are necessary to convince the quality of materials or their suitability shall be produced for inspection when required.
Any materials which have not been found to the specification and not approved by shall be rejected forthwith and shall be removed from the site by the Contractor’s at his own cost within the time stipulated. EIC 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

Cement shall be provided by the Contractor.

On the following types of cement as specified shall be used

a. Ordinary Portland Cement 43 grade confirming to BIS 8112-1987
b. Ordinary Portland cement 53 grade confirming to BIS 12269-1987
c. Portland Slag Cement conforming to IS 455.
d. Portland Pozzolona cement (flyash based) conforming to IS 1489 (Part- 1)

Cement at site shall be stored in dry weather proof go-downs (or shed) built by the Contractor at his own costs in stacks which are not higher than 10 bags. The cement go-down shall be constructed as per CPWD specifications. The contractor shall conduct all necessary tests as specified in the IS code of the cement supplied at the contractor’s cost to ascertain himself on quality of the material issued.

3.6.2 AGGREGATES

a) Aggregates from natural sources shall be in accordance with IS: 383. The contractor shall submit 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 1, II, III and IV. The contractor shall allow for and provide all necessary apparatus for carrying out each test and for supplying test records.

b) For fair faced concrete, the contractor shall ensure that aggregates are free from iron pyrites and impurities which may cause discoloration.

c) The fine aggregates shall be river sand, stone dust or other approved sand. It shall be free from clay, loan, earth or vegetables matter and from salt or other harmful chemical impurities. It shall be dean sharp, strong angular and composed of hard siliceous material.

The grading of sand as determined by the method prescribed in IS: 2386 part I shall be within the limits of grading zone III given in Table 1. When the grading falls outside the percentage limits given for sieves other than 600 micron, 300 micron, and 150 micron (I.S) sieves by not more 5 percent, it shall be regarded as falling within this zone. The 5 percent can be excess submission on one more sieves.

**TABLE 1**

<table>
<thead>
<tr>
<th>I. S. Sieve</th>
<th>ZONE I</th>
<th>ZONE II</th>
<th>ZONE III</th>
<th>ZONE IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 mm</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>90-95</td>
<td>90-100</td>
<td>90-100</td>
<td>95-100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>60-95</td>
<td>75-100</td>
<td>85-100</td>
<td>95-100</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>30-70</td>
<td>55-90</td>
<td>75-100</td>
<td>90-100</td>
</tr>
<tr>
<td>600 micron</td>
<td>15-34</td>
<td>35-59</td>
<td>35-60</td>
<td>80-100</td>
</tr>
<tr>
<td>300 micron</td>
<td>5-20</td>
<td>8-30</td>
<td>8-30</td>
<td>20-65</td>
</tr>
<tr>
<td>150 micron</td>
<td>0-10</td>
<td>0-10</td>
<td>0-10</td>
<td>0-15</td>
</tr>
</tbody>
</table>

The maximum quantity of silt as determined by the method prescribed in IS: 2386 Part II shall not exceed 8%. Stone dust shall be within the limits of Grading Zone III given in table 1. When the grading falls outside the percentage limits given for the sieves other than 600 micron and 300 micron (I.S) sieves by not more than 5
3.6.2.1 COARSE AGGREGATE

The coarse aggregate shall be crushed stone or broken stone. Coarse aggregate obtained from crushed or broken stone shall be angular, hay, strong, dense, durable clean and free from soft, friable, thin, flat, elongated flaky pieces. The coarse aggregate should be from the approved source/ quarantine.

Coarse aggregate River shingle or pit gravel shall be rounded, sound hard, clean, non porous, suitably graded in size with or without broken fragments and free from flat particle of shale, clay, silt, loam and other impurities.

Except where it can be shown to the satisfaction, a supply of properly graded aggregate of uniform quality can be maintained over the period of obtaining the coarse aggregate in different sizes & 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 form work.

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 and shall be in accordance with Clause 4.3 of IS: 456.

Before starting any concreting work and whenever the source of water changes, the water shall be tested for its chemical and other impurities to ascertain its suitability for use in concrete. No water shall be used until tested and found satisfactory. Cost of all such tests shall be borne by the contractor.

3.6.4 ADMIXTURES AND ADDITIVES

Chemical admixtures are not to be used until in case their use is permitted, the type, amount and method of use of any admixture proposed by the contractor shall be submitted for approval. The contractor shall further provide the following information concerning each admixture:

a) Normal dosage and detrimental effects, if any, of under dosage and over dosage.
b) The chemical names of the main ingredients in the admixture.
c) The chloride ion content, if any, expressed as a percentage by weight of admixture.
d) Whether or not the admixture leads to the entertainment of air when used in the manufacturer’s recommended dosage.
e) 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 as determined in accordance with IS: 6925 and the total chloride ion in all admixtures used in concrete mix shall not exceed 0.30n 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.

Regarding admixtures when used shall be based on lingo-sulphonates with due consideration to clause 5.2 and 5.30 of IS: 7861.

Waterproofing admixtures shall comply with IS: 2645.
3.7 PLANT
The contractor shall obtain the approval of the Engineer-in-charge for all plant items he proposes to use for the manufacture and placing of concrete. The arrangement shall maintain all items of plant at all times in a clean and efficient working condition.

3.8 STORAGE
All goods and products 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 & dust 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 micron polyethylene sheet so arranged that the flap closes on the top stack. The contractor shall ensure that protective polyethylene sheet is not damaged at any time during use.

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 and 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 Engineer in-charge before it is used in the works. Cement that has failed the tests conducted shall not be used in the works and shall be remarked from the site immediate by without fail.

3.8.2 STORING OF AGGREGATE
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 segregation of different size particles. The stacks shall be regular and of a height not exceeding two meters.

3.9 Grades of Concrete
The grades of concrete shall be in accordance with the following table. The grade of concrete to be used in each section of work will be shown in the drawings or in the Bill of Quantities:
CHARACTERISTIC STRENGTH

<table>
<thead>
<tr>
<th>Grade of Concrete</th>
<th>Grade of Concrete</th>
<th>Characteristic strength i.e. compressive strength of 15 cm. Cubes at 28 days (N/mm²)</th>
<th>Nominal aggregate size (mm)</th>
<th>Maximum aggregate size (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>10</td>
<td>25</td>
<td></td>
<td></td>
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<td>35</td>
<td>35</td>
<td>20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unless otherwise specified in the drawings, the maximum nominal size of coarse aggregates for different grades of concrete shall be as under:

a) For concreting in very narrow space or in very small thickness 12 mm
b) For all reinforced concrete work except in massive foundations 20 mm
c) For all ordinary plain concrete and massive reinforced foundations 10 mm

All mix design grades viz., M10, M15, M20, M25, M30 etc., shall be designed and have a minimum cement content as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Qty (in kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-10</td>
<td>220</td>
</tr>
<tr>
<td>M-15</td>
<td>240</td>
</tr>
<tr>
<td>M-20</td>
<td>310</td>
</tr>
<tr>
<td>M-25</td>
<td>330</td>
</tr>
<tr>
<td>M-30</td>
<td>340</td>
</tr>
</tbody>
</table>

Minimum content of cement remaining unchanged, as specified above for each type of concrete mix, the proportion and quantities of local sand and aggregate are to be worked out and determined in the field/laboratory as per Road Research Note No.4, Department of Scientific and Industrial Research, United Kingdom for design of concrete mixes or as per ACI 613 with the approval of the Engineer. Any change in the source of aggregates will require the re-designing of the concrete mix for the Engineer's approval.

3.10 Mix Design

General
At the commencement of the contract, the Contractor shall make preliminary tests to determine the proportions by weight of cement, fine aggregates, coarse aggregates and water necessary to produce required grades of concrete. The mix proportions shall be selected to ensure that workability of the fresh concrete is suitable for the conditions of handling and placing and when concrete hardens, it shall have the required strength, durability and surface finish. The Contractor shall get approval of the Engineer to such proportions before start of concreting. However, such approval shall not relieve the Contractor of his responsibility to produce concrete having compressive strengths as laid down in the foregoing table.

No departure from the approved proportions will be permitted during the works unless and until the Engineer gives written authorization for any change in proportion. The Engineer shall have authority at any time to check whether the mixing of concrete is being carried out according to the approved proportions.
For the major and important RC works and for all special works, the design of mixes shall be made by the Contractor at his own cost, for each grade of concrete as well as for various workability. The design of mixes shall be made according to relevant I.S. codes or to approved standard methods.

The concrete made by designing the mix is termed hereinafter as "Design Mix Concrete".

3.11 Water/Cement Ratio

Where a particular water/cement ratio is stipulated in the design or drawing along with the characteristic grade of concrete, the design of mix shall be carried out by adjusting the other variable factors to obtain characteristic strength of concrete with stipulated water/cement ratio.

In the structures where the impermeability and shrinkage of concrete have an important bearing on the durability and serviceability of the structures, such as water retaining structures, basements, underground premises, tunnels, pump houses, exposed structures near sea side or deserts, pre-stressed structure, thin precast members etc., the water/cement ratio shall be kept low and preferably not exceeding 0.45.

The water cement ratio as achieved in the mix design or as specified in the drawings shall be adhered to strictly and shall not be varied without the permission of the Engineer.

3.12 Workability

The workability of fresh concrete shall be such that the concrete is just suitable for the conditions of handling and lacing so that after compaction, it becomes completely consistent and homogeneously Surrounds all the reinforcement and completely fills the formwork.

The workability of fresh concrete at the place of batching/mixing shall be measured by compacting factor test and at the place of disposition by means of slump test. During the finalization of trial mixes, the relationship between compacting factor and slump test shall be established for each grade of concrete as well as for various levels for workability.

Normally, in the condition of low water cement ratio as well as for medium/high workability, the Workability shall be achieved by increasing the cement content.

In cases where the cement content is to be limited to reduce the heat of hydration, and the water / Cement ratio is also to be kept low to reduce the permeability or due to other requirements the desired Workability may be achieved with the se of limited doses of plasticizer or air entraining agent. In such cases, the method of mixing and dosage of the plasticizer / air entraining agent shall be according to the Manufacturer’s specification and with the approval of the Engineer.

Consistency and workability of concrete shall be checked by measuring the slump of a truncated cone of concrete straight from the mixer under normal working conditions. The conical mould shall be of metal, 300 mm high and 100 mm and 200 mm in diameter at top and base respectively.

Moulds shall be prepared by the Contractor. The slump range of concrete shall be as per the tabulation given below, as well as standards.

Slump tests shall be performed as per IS:1881 at intervals established by the Engineer at the Contractor's cost in such a Way as to check that the degree of consistency established by the Engineer for work in progress is maintained. The table below gives the general slump range to be followed for various types of construction unless otherwise shown on drawings or instructed by the Engineer.
3.7(b). The concrete mix will be designed for minimum workability as per the table given below:

<table>
<thead>
<tr>
<th>Placing conditions</th>
<th>Degree of workability</th>
<th>Slump (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightly reinforced sections in slabs, beams, walls and columns</td>
<td>Low</td>
<td>25–75</td>
</tr>
<tr>
<td>Heavily reinforced section in slabs beams, walls and columns</td>
<td>Medium</td>
<td>50–100</td>
</tr>
<tr>
<td>Pumped concrete</td>
<td>Medium</td>
<td>75–100</td>
</tr>
</tbody>
</table>

3.13 Durability

The durability of concrete, depending on the exposure condition, is to be taken into account while designing the mix. For given aggregates, the cement content should be sufficient to make sufficiently low water/cement ratio and Appendix A of IS: 456 shall be taken as guideline for durability considerations.

3.14 Trial Mixes

After approval of the mix design by the Engineer, the Contractor shall make in presence of the Engineer the trial mixes for each grade of concrete as well as for required workability.

Before starting the trial mixes, necessary preparatory works like determination of sieve analysis of the aggregates, densities of different ingredients, moisture contents in the aggregates, shall be completed according to the relevant BIS Codes.

Each trial mix shall be handled and compacted by the method which the Contractor proposes to use for that mix in the works and the mixes shall not show tendency of inadequate compaction by the method proposed.

The compacting factor and the slump of each trial mix shall be determined immediately after mixing and the values shall not exceed the maximum value obtained in the mix design.

Five (5) 150 mm test cubes shall be made from each trial mix. These shall be cured and tested in accordance with relevant BIS codes. In order to have the specified characteristic strength in the field, the concrete mix as designed in the design mix shall have higher average compressive strength depending on the degree of quality of control at site.

Before commencement of the concreting works of particular grade of concrete, the Contractor must complete the work of trial mixes and subsequent testing of the test cubes obtained there from and the desire of the approved mix for that particular grade of concrete.

The entire cost of all the trial mixes including all the preparatory works for trial mixes, preparation of test cubes and their testing shall be borne by the Contractor.

3.15 Nominal Mix Concrete

Nominal mix concrete may be used for all concrete of grade M-10 and below. If design mix concrete cannot be used for any reason for grade M-15 and M-20, nominal mix concrete may be used with the permission of the
Engineer. Nominal mix concrete shall be in accordance with Table-3 of clause 8.3 of IS 456. The stipulations of clauses 8.3.1 and 8.3.2 of IS: 456 shall also be taken into consideration.

3.16 Volumetric Mix Concrete

Where concrete is specified in volumetric proportions such as 1:4:8, 1:3:6, 1:2:4, 1:1.5:3, 1:1:2 etc., in the Bill of Quantities, coarse & fine aggregates shall be measured by volume & cement by weight. The water cement ratio shall be within 0.45 & 0.70 depending upon the workability.

3.17 Batching of Concrete

3.17.1 Cement

Cement shall always be batched by weight. A separate weighing device shall be provided for weighing cement. Where the weight of cement is determined by accepting the weight per bag, a number of bags shall be weighed separately to determine the average net weight of cement per bag and the same shall be checked regularly.

3.17.2 Aggregates

For both design mix concrete and nominal mix concrete, the aggregates,(coarse and fine) shall be batched by weight. In particular cases, or where weight-batching is not possible, proportioning by volume batching may be allowed by the aggregates throughout the period of construction. For this purpose, the Contractor shall submit to the Engineer sufficient data indicating the weight/volume relationship of the aggregates shall be made by the Contractor to the satisfaction of the Engineer. Where aggregates are moist and volume batching is adopted, allowance shall be bulking in accordance with IS (Part III). Suitable adjustments shall be made for the variation in the weight of aggregates due to variation in their moisture contents.

3.18 Water

3.18.1 General

Water may be measured either by weight or by volume. When measured by volume, it shall be by well calibrated conical shaped jar or vessel or from a calibrated tank filled to the mixer.

3.18.2 Adjustment of Water Due to Moisture Contents in Coarse and Fine Aggregates

It is very important to maintain the water cement ratio constant at its correct value. For the correct determination of the amount of water to be added in the concrete mix, to maintain the water cement ratio constant, the amount of moisture content in both coarse and fine aggregates shall be taken into consideration, be checked as frequently as possible, the frequency for a given job being determined by the Engineer according to weather condition.

3.18.3 Determination of Moisture Content in the Aggregates

Determination of moisture content in the aggregates shall be according to IS 2386 (Part-III). Where tests are not conducted, the amount of surface water may be estimated from the following table:

<table>
<thead>
<tr>
<th>Aggregates</th>
<th>Surface water</th>
<th>Carried by Aggregates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% by weight</td>
<td>l/m³</td>
</tr>
<tr>
<td>Very wet sand</td>
<td>7.50</td>
<td>120</td>
</tr>
<tr>
<td>Moderately wet sand</td>
<td>5.00</td>
<td>80</td>
</tr>
<tr>
<td>Moist San</td>
<td>2.50</td>
<td>40</td>
</tr>
<tr>
<td>Moist gravel stone chips*</td>
<td>125.25</td>
<td>20-40</td>
</tr>
</tbody>
</table>

* coarser the aggregate, less the water it will carry
3.18.4 Admixtures

Any solid admixture, to be added, shall be measured by weight, but liquid or semi-liquid admixture may be measured by weight or volume.

The Bidder shall indicate the brand name, the Manufacturer and the properties of any admixture to be used for the concrete as per Bill of Quantity items or on his own initiative.

3.18.5 Accuracy of Batching

The accuracy of batching shall be within the following tolerance:

1. Cement within + 2% by weight
2. Aggregate within + 5% by weight
3. Water within + 0.5% by weight.

3.19 Mixing of Concrete

3.19.1 Machine Mixing

Concrete shall always be mixed in mechanical mixer. Water shall not, normally, be charged into the drum of the mixer until all other ingredients are already in the drum and mixed for at least one minute. Mixing shall be continued until there is uniform distribution of materials and the mass is uniform in color and consistency. The mixing time from the time of adding water shall be in accordance with IS 1791, but in no case less than 2 minutes or at least 40 revolutions.

3.19.2 Hand Mixing

When hand mixing is permitted by the Engineer, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand mixing, 10% extra cement shall be added to each batch at no extra cost.

3.20 Transportation of Concrete

Concrete shall be transported from the place of mixing to the place of placing concrete as rapidly as practicable by any means, which will prevent the segregation or loss of any of the ingredients and maintain the required workability. No water shall be mixed with the concrete after it has left the mixer.

Where concrete is transported over long distances, the Contractor shall provide suitable means by which different grades of concrete are readily identifiable at the place of final deposit.

3.21 Preparatory Works/Surface Preparation

3.21.1 For Concrete Directly on Earth Foundation

Earth foundation on which direct placement of concrete is specified, shall be rammed and consolidated as directed by the Engineer such that it does not crumble and get mixed with concrete during or after placement. If the foundation is quite wet, the same shall be kept dry and then sufficiently consolidated, if necessary, a thin top layer of the wet soil shall be removed and replaced by sand or other suitable materials as directed by the Engineer without extra cost. Care shall also be taken that earth from the sides also does not get mixed with the concrete, during or after placement, before it has sufficiently set and hardened.

The earth foundation, over which concrete is to be placed directly, shall not be kept abandon at the specified level and concrete shall be placed immediately following otherwise suitable measures shall be taken, as directed by the Engineer without extra cost.
3.21.2 For Construction Joints

Concrete shall be cast, as far as possible, continuously until the parts of structure to be built are finished. Should this not be feasible, the type, number and location of construction joints shall be approved by the Engineer prior to placing concrete.

All such joints shall have continuous square bond grooves to produce substantial and water-tight-key and the exposed faces of joints shall be monolithic with the main mass of concrete formed and completed under substantially shattered faces. The Contractor shall take all the necessary steps by means of timber edgings etc. to ensure an exact horizontal straight finish to outside edge of any lift of concrete. Subject to the approval of the Engineer, the Contractor is at liberty to arrange his own construction joints but the following restrictions are to be observed:

1. There shall be no vertical construction joints

2. No longitudinal joints shall be made in the walls and floors of trenches and pits unless otherwise shown in the drawings.

3. Concrete pouring shall be reasonably large, but in no case shall the height of pouring concrete exceed 1.5 m without the Engineer's firm approval. Such approval of the Engineer shall not in any way relieve the Contractor of his responsibility to ensure that the construction is water tight and that no segregation takes place.

4. Laitance shall be removed from the surface of concrete before it has set hard by washing and wire brushing so as to expose the stones of the top layer without undue erosion of the mortar or damage to the under laying concrete.

All beds and joints in concrete faces, which have become set, are to be picked all over and all loose materials removed before fresh concrete is deposited thereon. The indentations shall be at least 12 mm deep and not less than seventy five percent of the area of the existing concrete face to be covered over.

Immediately before depositing fresh concrete, the exposed surface shall be cleaned of foreign matter by further wire brushing, if necessary. It shall then be thoroughly washed and surplus water removed. The surface, while still moist, shall be covered with layer of 1:1 cement mortar which must be vigorously stippled into the surface by means of a stiff brush, the depositing of the fresh concrete following on closely. Pockets to form keys shall be left in the surface of the concrete at constructional joints, 75 mm deep and approximately equal to 20% of the exposed surface.

All costs in connection with the forming of construction joints shall be to the account of the Contractor and shall be deemed to be included in the rates for concreting and formwork and shall not be separately paid for. In a column, the joint shall be formed 75 mm below the lowest soffits of the beams, including haunches, if any.

Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable, then the joint shall be vertical and at the centre of, or within, middle third of the span, unless otherwise shown on the drawings.

3.21.3 On Vertical Surfaces of Masonry

When the concrete is placed on the vertical surface of masonry (as in the case of thin concrete fins projected from the vertical masonry surface), a groove of dimension as directed by the Engineer shall be cut in the masonry to ensure a proper bond and the surface shall be cleaned thoroughly. Before the placement of concrete, the surface shall be kept moist by spraying water at least for the period of 2 hours and a thick coat of cement slurry shall be applied immediately before the placement of concrete.

3.21.4 Inside the Form Works (Cleaning, Surface Preparation etc.)

The interior of the form works, where the concrete is to be placed, shall be thoroughly washed by high pressure water jet or air jet to completely clean the entire volume from the dirt’s, grease/oil foreign and deleterious
materials etc. The reinforcements shall be completely cleaned and free from all sorts of dirt’s grease/oil, rust, foreign/deleterious materials etc. Before placement of concrete, the form works coming in contact with concrete, shall be coated highly with form oil or raw linseed oily material or provided with any approved material to prevent adhesion of concrete to the form work, but utmost care shall be taken so that such oily material does not come in contact with the reinforcement.

3.22 Placing and Compaction of Concrete

Before placing the concrete, the Contractor shall ensure that:

1. All mixing and placing equipment is thoroughly cleaned
2. All concreting space is free from debris and rubbish
3. All forms have been thoroughly wetted or oiled and firmly installed in line and plumb to the Engineer's approval.
4. All reinforcement is cleaned of loose rust, scales and other injurious adherents and is firmly bound and correctly placed and has been so approved by the Engineer.
5. All inserts, sleeves, foundation bolts and embedded parts have been correctly and firmly installed to conform to the Engineer's drawings and have been carefully checked to comply with the drawings. Special care shall be taken to locate and check sleeves or inserts, which may not be symmetrically placed with respect to centre lines.

The Contractor and Engineer shall separately inspect and check the above mentioned points and record and sign the results in a register which shall be maintained by the Contractor in a approved form. No concrete shall be placed without the Engineer having inspected and approved in writing. In spite of ensuring the above requirements, the Contractor shall fill pour cards furnishing the necessary details of the job, duly signed by the Engineer. This, however, will not absolve the Contractor from his responsibility to correctly execute the work. Pour cards shall contain the following information:

Design Index
- Date
- Slump
- Workability
- Work test specimen
- Type of finishing and admixtures used (if any)
- Period of removal of shuttering/props/forms.

a) The concrete pouring method shall be submitted to the Engineer for approval and shall always be such as to avoid any possibility of segregation of the components or shifting of the reinforcement.

b) Special grout or mix shall be used for difficult and intricate locations as specified by the Engineer. During placing, the concrete shall be thoroughly worked around reinforcement, embedded parts and corners of the formwork.

c) Greatest possible care shall be taken by the Contractor that reinforcement and embedded parts, particularly foundation bolts and sleeves are not displaced during placement of concrete. While concreting mats and other such locations where top and bottom reinforcement are adopted, top reinforcement shall be thoroughly cleaned of all slurry and mortar sticking to them at the time of concreting top layers.

d) The concrete shall be placed and compacted before setting commences and should not be subsequently disturbed. No water shall be mixed with the concrete after it has left the mixer. Method of placing should be such as to preclude segregation. Approved mechanical vibrator shall be used for compacting concrete, and concrete shall not be non vibrated or under vibrated. No concrete shall be placed until the place of deposit has been thoroughly inspected and approved by the Engineer, all inserts and embedment properly secured in position and checked and forms properly oiled. No concrete shall be placed in the absence of the Engineer.

e) Concrete shall be placed on clean bed having the designed level. The bed shall be cleaned of all debris and other objectionable materials. Seepage water, if any, shall be controlled or diverted.

f) Concreting shall not be carried on during rains unless all precautions have been taken by the Contractor and necessary permission has been given by the Engineer. Suitable measures shall be taken to control the temperature of concrete.
g) Where plums are permitted in massive concrete, they shall be washed and carefully placed. No stone shall be closer than 30 cm to an exposed face, nor nearer than 15 cm to an adjacent stone.

h) Concrete shall not be dropped from a height of more than 2 m except through a chute, the design and type of which shall be subjected to approval of the Engineer.

i) The concrete shall be placed, spread and compacted by approved mechanical vibrator. Vibrators shall not be used for pushing concrete to adjoining areas.

j) For members involving vertical placing of concrete (e.g., columns, walls etc.), each lift shall be deposited in horizontal layer extending for the full width between shuttering and of such depth that each layer can be easily and effectively vibrated and incorporated with the layer below by means of compaction being employed.

k) For members involving horizontal placing of concrete (e.g., slabs, beams etc.), the concrete shall be placed along the line of starting point in such quantities as will allow members to be cast to their full depth along the full width between side shuttering and then gradually brought towards the finishing point along its entire front parallel to the starting line vibration and surface finish shall follow behind the placement as closely as possible.

l) Utmost care shall be taken to avoid the displacement of reinforcements/ embedded parts or movement of form work or damage to faces of the form work or transmission of any harmful vibration/shocks to the concrete which has not yet hardened sufficiently.

m) All members shall be concreted at such a rate that no cold joint is formed and fresh concrete is placed always against green concrete, which is still plastic and workable. n. Should any unforeseen occurrence result in a stoppage of concreting for one hour or such other time as might allow the concrete, already placed, to begin to set before the next batches can be placed, the Contractor shall make at his own cost, suitable tongue, and groove construction joint, as approved by the Engineer. Any additional reinforcement required as directed by the Engineer shall also be provided by the Contractor at his own cost. Before placement of new batches of concrete over that construction joint, the surface preparation according to this specification stipulated earlier, shall be done by the Contractor.

n) The concrete shall be worked well up against whatever surface it adjoins and compacted to such a degree that it reaches its maximum density as a homogeneous mass, free from air and water holes and penetrates to all corners of moulds and shuttering and completely surrounds the reinforcement. All measures shall be taken to make the shape, size, and location of the finished concrete including its embedment, holes, openings etc, well within the accepted tolerance limit.

3.23 Construction Joints

Normally, the construction joints including crack inducing joints shall be constructed as per locations and details indicated on the drawings. Where the location of the joint is not specified in the drawings, it shall be in accordance with the following guidelines. In all construction joints, the reinforcements shall pass through as per drawings and the same shall not be disturbed in any way.

a) In Columns

i) In case of Projection from Basement Slab, 300 mm from the top of base slab or 75mm from the top of the haunches whichever is higher.

ii) In framing the beam at different elevation, 75 mm below the lowest soffit of the beam and in case of projection from beams and slabs 75 mm from the tope surface of the beam/slab or at the top surface of beam/slab whichever facilities formwork.

iii) For columns below flat slabs, 75 mm below the lowest soffit of the slab.

b) In Walls (Horizontal Construction Joints)

i) For Walls Projecting from Base Slab, 300 mm from top of base slab.

ii) For Walls supporting the suspended slab, 75 mm from the lowest soffit of the slab.

Note: In the case of water retaining structures and structures under the influence of ground water, approved water bars of suitable size shall be provided to make the joint completely watertight.

c) In Beams
Beams shall be cast, as a rule, without a joint. But if provision of a joint is unavoidable, the joints from simply supported beam shall be vertical and at the middle of the span; in continuous beam, the same shall be at the point of minimum shear force.

d) In Suspended Slabs
   i) In slab of small span, there shall be reconstruction joints.
   ii) In slabs of large span and continuous slabs, the Construction joint, if allowed by the Engineer, shall be vertical at the middle of span and at right angles to the principal reinforcement.

e) In Walls (Vertical Construction Joint)

As a rule, walls shall be cast monolithically without any vertical construction joint, unless specified in the drawing. However, for a long wall, Engineer may allow vertical construction joint and the same shall be at the place of minimum shear force.

f) In Slabs Resting on Ground
   i) For Plain Concrete
      Concreting shall be done in alternate panels not exceeding 10 m² in area. The largest panel Dimension shall be 5 m.
   ii) For Nominally Reinforced Slab The area of pour shall not exceed 40m² and the maximum panel dimension shall not exceed 8m.
   iii) For the Basement Slabs Which Act as Structural Member
      These shall be no construction joint.

g) In Ribbed Beams
The beams shall be monolithically with the slab in one continuous operation.

3.24 Cold Joints

An advancing face of pour, which could not be covered before expiry of initial setting time for unexpected reasons, is called a cold joint. The Contractor shall remain always vigilant to avoid cold joints. If however, a cold joint is formed due to unavoidable reasons, the following procedures shall be adopted for treating it:

1. If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly over the old surface and the fresh concrete along with the old concrete shall be vibrated systematically and thoroughly.
2. In case the concrete has hardened a bit more than (a), but can still be easily removed by a light hand pick, the surface shall be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. Then a rich mortar layer of 12 mm thickness, shall be placed on one cold joint and then the fresh concrete shall be placed on the mortar layer and vibrated thoroughly penetrating deep into the layer of concrete.
3. In case the concrete at the joint has become so stiff that it cannot be remolded and mortar or slurry does not rise in spite of extensive vibration, a tongue and groove joint shall be made by removing some of the older concrete and the joint shall be left to harden at least for 12-24 hours. It will then be treated as regular construction joint and the surface preparation of the same, before placement of concrete, shall be as described in the appropriate clauses of these Specifications.

3.25 Sub-standard concrete

Should the work strength of controlled concrete fall below the specified strength, Engineer shall decide:

1. To reject the work, in which case the Contractor shall replace the defective work with concrete of required strength and bear all costs for dismantling and replacing including cost of associated form work, reinforcement, embedded parts & all associated works.
2. To accept the work at a reduced rate, in which case the unit rate payable for sub-standard work will be reduced by ..., directly in proportion to the work strength as compared to the specified strength. The Engineer may, in addition, require other tests performed on the respective structural member so accepted period to its acceptance with or without necessary corrective measures and in each such case,
the Contractor shall bear all costs for all such tests or corrective measures, besides the reduction in the unit rates as specified herein.

3. Concrete of strength below fifteen (15) percent of the specified strength will not be accepted.

4. The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap under the members. The test load shall be maintained for 24 hours before removal.

5. If, within 24 hours of the removal of the load, the structure does not show a recovery of at least 75% of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75% of the maximum deflection shown during the second test. If the structure is certified as failed by the Engineer, the cost of the load test shall be borne by the Contractor.

3.24 Optional Tests

The Engineer, if he so desires, may order tests to be carried out on cement, sand, coarse aggregate, water in accordance with the relevant Indian Standards.

Tests on cement shall include
1. Fineness test
2. Test for normal consistency
3. Test for setting time
4. Test for soundness
5. Test for tensile strength
6. Test for compressive strength
7. Test for heat of hydration (by experiment and by calculation) in accordance with IS: 269.

Tests on sand shall include
1. Sieve test.
2. Test for organic impurities.
3. Decantation test for determining clay and silt content.
4. Specific gravity test.
5. Test for unit weight and bulk age factor.
6. Test for sieve analysis and fineness modulus.

Tests on coarse aggregates shall include
1. Sieve analysis.
2. Specific gravity and unit weight of dry, loose and rodded aggregate.
3. Soundness and alkali aggregate reactivity.
4. Petrographic examination.
5. Deleterious materials and organic impurities.
6. Test for aggregate crushing value.

Any or all these tests would normally be ordered to be carried out only if the Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by the Contractor or at an approved test laboratory at the cost of the Contractor. If the work cubes do not give the stipulated strengths, the Engineer reserves the right to ask the Contractor to dismantle such portions of the work which, in his opinion, are unacceptable and re-do the work to standards stipulated, at the Contractor's cost. The unit rate for concrete shall be all inclusive, including making preliminary mix design and test cubes works, cubes, testing them as per specification, slump tests, optional tests etc.,

3.27 Concrete for Equipment or steel structures foundations

Concrete for equipment foundation, whether principal or auxiliary, shall be poured continuously so that the structure becomes monolithic, particular care being exercised to see that the base slabs, if any, are of compact impervious construction. Tunnels, passages, apertures and so forth shall be provided in accordance with the drawings for the installation of mechanical and electrical equipment, pipes or cables. The top elevation of the equipment foundations or parts shall be accurately cast to 20/50 mm (or more as may be specified on the drawings) above the level required for grouting and it shall be pneumatically chiseled off and well roughened.
just prior to the erection of the equipment concerned. All embedded anchor bolts or bolt sleeves shall be accurately and firmly set with the aid of approved templates, steel supports and/or other accessories. For holding the embedded bolts or sleeves in the correct position during concreting, template shall have to be of steel of suitable section approved by the Engineer. Two sets of templates shall have to provided, one to hold the bottom and the other the top of the bolts or sleeves. The bottom template shall be securely and rigidly fixed by providing anchorage arrangement and by welding to the lowest part of the steel reinforcement and other structural supports. The top templates shall be securely fixed by tying with guy wires and turn buckle arrangements to firm and rigid adjoining structures and staging. The bottom template that is embedded in concrete will be measured and paid for as embedded steel.

Bolt pockets, where required, shall be cast with wooden taper wedges. These shall be withdrawn at an appropriate time when the concrete has set, the pockets cleaned, roughened and then covered or blocked thoroughly to prevent debris getting into these. The exposed portions of bolts and embedded parts shall be kept well greased and adequately protected from damage throughout construction. Any damages found shall have to be corrected at the Contractor's cost. shall have the right to use the foundations, pads, piers, slabs, floors and all concrete work as needed for other works or equipment erected prior to its "Taking Over".

3.28 Requirements for Concreting in Special Cases

3.28.1 Concreting in Deep Lifts

Placing of concrete in lifts exceeding 3 m in columns and 2 m in walls is in the category of deep lifts.

Before commencement of work, the Contractor shall submit for the approval of the Engineer, the details of the methods he proposes to adopt for concreting. The placement of concrete shall preferably be by tremie chute or any other approved method.

In structures of heavy/complicated reinforcement or in complicated form works, the Contractor shall provide sufficient number of windows in the form works as directed by the Engineer to check the placement and compaction of concrete in different stages. Such windows shall be closed as soon as the concreting reaches the bottom level of the same.

3.28.2 Concreting Under Water

The mix and method of concrete to be placed under water shall be approved by the Engineer. Under water, concrete shall contain at least ten (10) per cent more cement over that required for normal placement.

An account of extra cement so used shall be maintained by the Contractor and the Engineer jointly and the extra cement used shall be separately paid for. Plumbing of water shall not be permitted for twenty four (24) hours after completion of placement. No flow of water, natural or artificial, shall be permitted during placement and up to twenty four (24) hours after completion of placement.

3.28.3 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 4.5oC or below during the placing and curing period, the work shall conform to IS: 7861 (Part-II).

3.28.4 Hot Weather Concreting

Concrete shall not normally be placed when the atmospheric temperature exceeds 40°C in the open. If, in spite of programming concrete work in the cooler hours of early morning, evening or night, placement is necessary in too hot a weather, then the Contractor shall take at least the following additional precautions:

1. Stock-pile aggregates in shade
2. Do not use fresh, factory hot cement
3. Use cold water
4. Cool form work by sprinkling water without collecting water inside
5. Reduce to minimum the time interval between mixing and placing
6. Place, vibrate and finish as quickly as possible
7. Initiate curing as soon as concrete hardens.
Positive temperature control by methods like pre-cooling, post cooling or cooling of concrete by circulating cold water through small embedded pipe lines inside concrete, if required, shall be specified and shall be undertaken.

3.28.5 Concreting in Large Pours (Mass Concrete)

The aim of controlling the concreting in large pours is to reduce cracking caused by shrinkage due to heat of hydration. The Contractor shall submit detailed proposal to the Engineer for approval about the method of pouring and the measures to reduce heat of hydration, which he proposes to adopt. The maximum height of lifts will depend on the type of cement used. The use of cement having low heat of hydration, could allow greater lifts. The Contractor shall provide all the necessary arrangements like pre-cooling of aggregates, cooling of fresh concreting by passing cold water through pipes placed inside the concrete or such other measures at least 38 hours before the placement of concrete and also provide the facility for recording of temperature at least 24 hours prior to placement of concrete. The minimum interval between concreting of successive lifts, separated by horizontal construction joint, shall be six days or as directed by the Engineer.

The minimum interval between the concreting of adjacent pours separated by vertical construction joints shall be three (3) days, or as directed by the Engineer.

3.29 Finishes to Exposed Surface of Concrete

The Contractor is to include his quoted rate for concrete, the provision of normal finishes in both formed and unformed surfaces as and where required by the Engineer without any extra cost. Some common finishes are indicated below:

3.29.1 Surfaces which do not require Plastering

Surface in contact with casing shall be brought to a fair and even surface by working the concrete smooth against casings with a steel trowel while it is being deposited and also by working over the surface with a trowel immediately after the removal of the casings or centering, removing any irregularities and stopping air holes, etc. Use of mortar plaster is not permissible for correcting levels, removing unevenness etc. However, if in the opinion of the Engineer, such plastering is unavoidable, then the thickness of plaster shall in no case exceed 5 mm and the plastering shall be in CM (1:3).

3.29.2 Faces of Foundations which will be Back Filled

Neither the smoothness of the surface nor the positions of the joints in the form work are important. Small blemishes caused by entrapped air are permitted. No special surface finish is required.

3.29.3 Exposed Surfaces

Surface of beams/columns flushing with the block work or other structures where it is intended to plaster, shall be backed adequately as soon as the shuttering is stripped off so that proper bond with the plaster can develop.

3.29.4 Surface for Non-integral Finish

Where a non integral finish such as floor finish is specified or required, the surface of the concrete shall be struck off at the specified levels shall be furnished and finished rough.

3.29.5 For Monolithic Finish

Where no more finishing course is to be supplied as in the case of basement floor, industrial flooring or the screed concrete flooring etc., the concrete shall be completed and struck off at the specified levels and slopes in a screed board and then floated with a wooden float. Steel troweling is then started after the concrete has
hardened enough to prevent the excess of fines and water to rise to the surface but not hard enough to prevent proper finishing. Trowelling shall be such that the surface is flat, smooth and neatly finished.

3.30 Curing of Concrete

3.30.1 General

The purpose of curing is either to provide sufficient water at optimum temperature or to prevent loss of moisture from the concrete itself so that the cement inside the concrete is sufficiently hydrated which, of course, is a slow and prolonged process. As soon as the concrete has hardened sufficiently, the curing shall be started.

3.30.2 Different Methods of Curing

Any one of the following may be used for curing as approved by the Engineer.

a) Curing by Direct Water

This is done either by pounding or spraying water.

**Pounding**

Pounding is widely used for curing slabs and pavement. Earth bands are formed over the slabs and water is pumped or poured into them and the same is replenished at interval to make up for the loss of evaporation. As this type of curing is one of the best methods, 10 days of curing after final setting is sufficient.

By Spraying Water Curing is done by spraying water by suitable means at approved time intervals. While spraying, it shall be ensured that the complete area is covered. In order to avoid cracking, cold water shall not be applied to massive members immediately after striking the form work, while the concrete is still warm. Alternative wetting and over drying shall be avoided.

Curing by spraying water shall be continued as least for 18 days.

b) Curing of Concrete with Absorbent Material Kept Damp

The entire concrete surface is covered either with hessian, burlap, sawdust, sand, canvas or similar material and kept wet continuously for at least 12 days after final settings.

b) Curing by Covering Concrete Surface with an Impressive Sheet

This is achieved by covering the entire concrete surface with water proof paper or plastic sheets specially manufactured for this purpose. The waterproof papers are stuck together by adhesive compound and the plastic sheets can be welded at site. Such type of covering shall be kept at least for 24 days after the final setting. It is preferable to have sheet as white in appearance since the white colour will reflect hot sunrays and keep the concrete temperature at reasonable level.

c) Curing by Providing Protective Membrane by Applying curing compound

This is achieved by applying a membrane forming compound (curing compound) over the concrete surface. Generally, these are available in the emulsion form. The application of the curing compound should be started immediately after stripping off the shuttering in case of formed surface and after the surface has hardened in case of unformed surface.

The curing compound membrane forming emulsions dry up within 3 to 4 hours after application and forms a continuous coherent adhesive membrane over the concrete surface. Such membrane serves as a physical barrier to prevent the loss of moisture from the concrete itself. Membrane forming emulsions are generally coloured black or white to improve

Visibility for ensuring uniform application. Black colour shall never be used for curing in very hot weather. In order to prevent glare, a colouring pigment may be added to white compounds.
Black curing compounds are either Bituminous or Asphaltic emulsions and shall be used to surfaces which are to be covered by back filling or on the floor which is to be covered with tiles and linoleum.

White curing compound shall be used for the surfaces of tall structures under exposure of hot sun where other method of curing cannot be properly ensured.

d) Curing by Chemical Coating

For chemical curing, sodium silicate or calcium chloride is used. The use of calcium chloride shall be done with the approval of the Engineer. Normally, the sodium silicate mixed with water is applied over concrete surface and, when it dries up, it forms a thin varnish like film, which fills up the pores, and surface voids and prevents evaporation of water. This also acts like curing compound but only difference is that curing compounds are available in ready mixed emulsion forms while sodium silicate is to be mixed with water at site.

3.30.3 Limitation to Use of Different Methods of Curing:

i) Curing by the processes as indicated in Section B – Clause 3-24 and more specifically as per sub-clause 2(b) of the above clause gives very good results in normal warm climate for maturity of concrete.

ii) In cold weather, the process as indicated in sub-clause 2(b) of clause 3-24 gives very good result for maturity of concrete.

iii) Where water cement ratio is less than 0.5, the methods indicated in sub-clause 2(d) and 2(e) of clause 3-24 of Section B, shall not be used.

3.31 Testing of Concrete

3.31.1 General

The Contractor shall carry out, entirely at his own cost, all sampling and testing in accordance with the relevant IS standards and as supplemented herein. The Contractor shall get all tests done in an approved laboratory and submit to the Engineer, the test result in triplicate within 3 days after completion of the test.

3.31.2 Consistency Test (Tests of Fresh Concrete)

At the place of deposition/pouring of the concrete, to control the consistency slump tests and/or compacting factor tests shall be carried out by the Contractor in accordance with IS 1199 as directed by the Engineer.

The results of the slump tests/compacting factor tests shall be recorded in a register for reference duly signed by both the Contractor and the Engineer. That register shall be considered as the property of ... and shall be kept by the Contractor at site in safe custody.

The results of the slump tests/compacting factor tests shall tally, within accepted variation of 12%, with the results in the respective design mix, in case of mix design concrete and with the values indicated in the table under clause 6.1 of IS:456 in case of nominal mix concrete.

For any particular batch of concrete, if the results do not conform to the requirements as specified in IS 456, the Engineer has the right to reject that batch and the Contractor shall remove the same immediately from the site, at no cost ... .

3.31.3 Strength Test of Concrete

While placing concrete, the Contractor shall make six (6) 150 mm test cubes from particular batches of concrete as desired by the Engineer. The frequency of taking test cubes shall be either according to clause 14.2 of IS:456 or as directed by the Engineer.

The cubes shall be prepared, cured and tested according to IS 516. Out of the six (6) test cubes, 3 shall be tested for compressive strength at 7 days after casting and the remaining 3 at 28 days after casting A register shall be maintained at site by the Contractor with the following details entered and signed by both the Contractor and the Engineer. That register shall be considered as the property of ...
a) Reference to the specific structural member
b) Mark on cubes
c) The grade of concrete
d) The mix of concrete
e) Date and time
f) Crushing strength at 7 days
g) Crushing strength at 28 days
h) Any other information directed by the Engineer.

3.31.4 Acceptance Criteria for Test Cubes

The acceptance criteria of concrete on strength requirement shall be in accordance with the stipulations under clause 15 of IS: 456.

3.31.5 Non-destructive Tests on Hardened Concrete

3.31.6 If there is doubt about the strength or quality of a particular work or the test results do not comply with the acceptance criteria as stipulated under clause 15 of IS:456, non-destructive tests on hardened concrete like core tests and/or load tests or other type of non destructive tests like ultrasonic impulse test etc. shall be carried out, as may be directed by the Engineer, by the Contractor at entirely his own cost.

The core tests and load tests shall comply with the requirements of clause 16.6 of IS: 456 shall be applicable.

3.31.7 Concrete below Specified Strength

In case of failure of test cubes to meet the specified requirements, the Engineer may take one of the following actions:

1. Reject the work and instruct that section of the works to which the failed cubes relate shall be cut out and replaced at the Contractor's expense.
2. Instruct the Contractor to carry out additional tests and/or works to ensure the soundness of the structure at the Contractor's expense.
3. Accept the work with reduction in the rate in appropriate item.

3.31.8 Concrete failed in Non-destruction Tests

In case test results of the core tests or load tests in a particular work do not comply with requirements of respective clause (16.3 for core test and 16.5 for load tests) of IS 456, the whole or part of the work concerned shall be dismantled and replaced by the Contractor as may be directed by the Engineer no extra cost ..., and to the satisfaction of the Engineer. No payment for the dismantled concrete including relevant form work, reinforcement, embedded fixtures etc. shall be made. In the course of dismantling if any damage occurs to the adjacent structure or embedded item, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

3.32 EXPANSION JOINTS

3.32.1 GENERAL

Expansion joints shall be provided where shown on the drawings or as directed. 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 drawings.

Contractor shall ensure that expansion joints are made water-tight and that no leakage occurs through these joints for which he shall be responsible to redo at his own cost.
3.32.2 OPEN JOINT FILLERS

Where shown on the drawings, open joints in the structure shall be filled with joint fillers.

The joint filler shall be easily and uniformly compressible to its original thickness, tampable, easily cut or sawn, robust, 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.

3.32.3 JOINT SEALING COMPOUNDS

Joints 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 shall have good extensibility and adhesion to concrete surfaces and shall have resistant to flow and weathering. Polysulphide joints where specified on the drawings shall be seated with polysulphide liquid polymer, stored, mixed handled, applied and cured strictly in 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 sealant shall be of an approved manufacturer. The treatment of the joint and the use of sealing compound shall be strictly in accordance with the manufacturer’s written instructions.

3.32.4 WATER BARS

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 heated jig.

Jointing and fixing of water-bars shall be carried out strictly in accordance with the manufacturers 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 presented adjacent to water-bars, adequate clearance shall be left between the reinforcement and water-beds to facilitate of the concrete.

3.33 CRACKS

If any cracks develop in the reinforced cement concrete construction which 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 cracks shall develop further the contractor at his own expense shall dismantle the construction, cart away the debris, replace the construction and carry out all consequential work there to at no extra cost. If the cracks are not detrimental to the stability of the construction, 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 floods, roofs, Ceiling etc. which have suffered damage either in appearance or stability owing to such cracks.

The repair work shall be carried out to the satisfaction of the Engineer-in-charge. The decision of the Engineer-in-charge as to the extent of the liability of the contractor in the above matter shall be final and binding on the contractor.
3.34 SUPERVISION

All concreting work shall be done under strict supervision of the qualified and experienced representatives of the Contractor. 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:-

(a) Proportioning, mixing and quality testing of the materials with particular control on the water cement ratio.
(b) Laying of material in place and thorough compaction of the concrete to ensure solidity and freedom from voids and honey combing.
(c) Proper curing for the requisite period.
(d) Reinforcement and inserts/embediments position are not disturbed during concreting and consolidation by vibration.

3.35 QUALITY CONTROL

The Engineer-in-charge 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.

3.36 TOLERANCES

The acceptable tolerances for formed concrete surfaces shall be given below: -

a) Variation from plumb for -
   i. Columns and walls to be rendered 6 mm in 3 meters
   ii. Exposed columns and walls 3 mm in 3 meters
b) Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls: - 6 mm 
   & + 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 as desired /Engineer-in-charge.

3.37 TESTING ROOM

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 cost:

1. Sieve Set (For aggregate 20 mm down)
   40 mm, 20 mm, 16 mm, 12.5 mm, 10 mm, 4.75 mm, 600 micron, 300 micron, and 75 micron having diameter of 45 cms.

2. Weighing
   a) Physical balance cap. 200 gms with weigh box (accuracy 0.5 gm)
   b) Counter Scale cap 20 Kg
   c) Weights
      
      | Weight | Quantity | Size (gms) |
      |--------|----------|------------|
      | 5 kg   | 1 No.    | 500 gms    |
      | 2 kg   | 2 Nos.   | 200 gms    |
      | 1 kg   | 1 No.    | 100 gms    |

3. Slump Cones 2 Nos
4. 15 cms moulds 18 no.
5. Electric/Kerosene Heater
6. pans etc. as directed
7. Measuring Cylinders of 1000 ml., 500 ml and 100ml.
8. Wash bottles of the Capacity of 500 ml., 2 Nos.
9. Sink
10. Work benches, shelves, desks and any other furniture and lighting as required.
11. Spring balance dial type cap. 100 kg
12. Litre measures
   a) 10 Lit 1 No.
   b) 5 Lit 1 No.
   c) 2 Lit 2 Nos
   d) 1 Lit 1 No.
   e) 1/2 Lit 1 No.
14. Oven.

3.38 CO-ORDINATION OF WORK

The contractor is fully responsible for coordinating with the other agencies for sanitary, electrical work, 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 and 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.

4 SPECIFICATIONS FOR STEEL REINFORCEMENT

4.1 GENERAL

4.1.1 DESCRIPTION

This section covers the requirements for fabricating, delivering and placing of steel reinforcement in position for casting all types of concrete work.

4.1.2 RELATED WORK SPECIFIED ELSEWHERE

Applicable Codes and Standards:

IS: 280 Mild wire for general engineering purpose
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: 2502 Code of Practice for bending and fixing of bars for concrete reinforcement

The following clauses are intended to amplify the requirements of the reference documents listed above and the contractor/Engineer-in-charge shall comply with these clauses.

4.2 SUBMITALS

4.2.1. BAR BENDING SCHEDULE

The Contractor shall prepare Bar Bending Schedule for reinforcement before fabrication

4.3 MATERIALS
4.3.1 STEEL REINFORCEMENT

Steel reinforcement to be procured by the Contractor for works shall be either of the following types:-
(a) Mild steel of Grade 1 tested quality conforming to IS: 432-Part
(b) 3370 Code of practice for concrete structures for (Part 1 to IV) the storage of liquids
(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 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 and IS: 4759. Galvanized reinforcement shall be coated with a layer of zinc nowhere less than 0.05 mm in thickness.

All reinforcement shall be stored horizontally above ground level on supports, skids or other approved supports, clear of any running or standing water. Contact with soil should be avoided. Proper drainage and protection from the elements shall be provided to minimize corrosion.

Before steel reinforcement is placed in position, the surface of the reinforcement shall be cleaned of rust, dust, grease and other objectionable substances. In order to confirm their self the quality periodical tests as specified as the relevant IS shall be conducted by the contractor at his own cost for the materials procured by the Contractor.

4.3.2 BINDING WIRE

Binding wire shall be black annealed steel wire conforming to IS: 280 and of minimum 18 gauges.

4.3.3 WELDING ELECTRODES

Electrodes used for welding of steel bars shall be of ordinary mild steel grade electrodes conforming to IS: 814 and shall be of the best quality approved.

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 soil 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 works in which particular reinforcement is used can be readily identified.

Welding electrodes shall be stored in moisture control-led 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 / Engineer-in-charge.

All reinforcement shall be bent cold using appropriate pin size. Bars may be preheated only on approval. Quenching shall not cool hot bars. Bends shall be in accordance with IS: 2502.

It shall be ensured that the bars are not straightened in any manner that will injure the material. Any bars incorrectly bent shall be used only if means for straightening and rebinding be such as not to affect adversely the material. Reinforcement shall not be re-bent or straightened without prior review. No reinforcement shall be placed in position on the works without approval, 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 an approved zinc paint immediately after cutting.

4.6 LAPING

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 Engineer-in-charge.

Laps shown on the drawings or otherwise specified shall be based on the used 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 /Engineer-in-charge.

Not more than 1/3 rd 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 / Engineer-in-charge.

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. Pre-cast cement concrete blocks of required shapes and size, MS. chairs and spacers bars shall be used in order to ensure accurate positioning of reinforcement. Pre-cast 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 withdrawn as compaction of concrete proceeds. Spacers will not be permitted to be left in fair faces of concrete.

All intersections of the reinforcements shall be securely tied with two strands of binds 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 / Engineer-in-charge. Nothing extra will be paid for tack welding.

The contractor shall take all responsible 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 filed bent partially embedded in concrete shall not be field bent unless concurrence has been obtained from the Engineer-in-charge.

Walkways and borrow runs 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 form work prior to concrete placing.

Without relieving the Contractor of the responsibilities for the correctness thereof, the reinforcement shall be inspected and approved in writing before any concrete is placed and the contractor shall allow sufficient time for such inspecting 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 cares shall be taken to maintain the correct cover to reinforcement.
For concrete members exposed to weather, earth, action of harmful chemicals, acid vapor, saline atmosphere, sulphurous smoke etc minimum cover for reinforcement shall be increased by 15 cm to 40 mm as directed / Engineer-in-charge.

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 bundle but need not be greater than 50 mm.

Exposed reinforcement intended for binding with future extensions shall be protected from corrosion as shown in the drawings.

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 mould 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 cutting to lengths, labour in bending and cranking, forming hook ends, handling, hoisting and all that is necessary to fix reinforcement in work as per Drawings and specifications This shall also include all that is fairly intended and is necessary for completion of work.
b) Cost of pre-cast concrete cover blocks to maintain cover and holding reinforcement in position, chairs, spaces, dowels, pins, laps, etc.
c) For fabricating and fixing reinforcement in any structural member irrespective of its location, dimension and level.
d) Work at all levels.
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) Reinforcement Steel procurement shall be done by the Contractor.

5 SPECIFICATIONS FOR FORMWORK

5.1 GENERAL

5.1.1 DESCRIPTION

This section covers the requirements for providing, fabricating and erecting of form work including propping, bracing, shoring, strutting, rising, bolting, wedging and all other temporary and all other temporary supports to the concrete during the process of setting 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: 4990 Ply wood for concrete shuttering work.
5.2 SUBMITTALS

5.2.1 TYPE OF FORM WORK

Prior to start of delivery of material for formwork, the contractor shall prepare samples of different types of formwork for about 10sqm and obtain approval.

5.2.2 DESIGN OF FORMS

Before fabricating of forms, the contractor shall submit design calculations for proposed form work /Engineer-in-charge for his approval. However, the approval 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 /Engineer-in-charge for his Approval.

5.3 MATERIALS

5.3.1 Formwork shall be timber, plywood, steel or any other material 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 finished and safety.

5.3.2 TIMBER

Timber used for formwork shall be easily workable with nails without splitting. It shall be stable and into 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

5.3.4 STEEL

Steel form work shall be made of minimum 2 mm thick or more as required black sheets stiffened with angle iron frame made out of M S angles 40 mm X 6mm.

5.4 DESIGN CRITERIA

Formwork shall be designed for the loads and lateral pressures due to dead weight of concrete, superimposed live loads of workmen, materials and plants and for other loads as indicated on the drawings. Forms shall be designed to have sufficient strength to carry on 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. 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 or specified, the camber shall be provided as below:-


<table>
<thead>
<tr>
<th>Types of member</th>
<th>Compression Steel</th>
<th>Camber Co-efficient</th>
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</thead>
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<tr>
<td></td>
<td>As % of tensile</td>
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<tr>
<td></td>
<td>steel</td>
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<tr>
<td>Simple span</td>
<td>0%</td>
<td>0.066</td>
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<tr>
<td>Continuous Restrained</td>
<td>50%</td>
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<tr>
<td>span Cantilever</td>
<td>0%</td>
<td>0.032</td>
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<tr>
<td></td>
<td>50%</td>
<td>0.020</td>
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<td></td>
<td>0%</td>
<td>0.086</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>0.046</td>
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</tbody>
</table>

Camber in cms Where \( \frac{K \times L \times 2.54}{D} \)

K = Camber coefficient
L = Length of member in meter
D = Depth of member in meter

5.5 ERECTION OF FORMWORK

Forms shall be used wherever necessary to confine the concrete during vibration and to shape it to the required line. 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 pressure resulting from placement and vibration of concrete and shall be maintained rigidly in position. Form work 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 sufficient size so as to restrict the bearing on the ground to 50 t/sqm.

Forms shall be tight enough to prevent loss of mortar from the concrete and to produce dense, homogenous and uniformly coloured concrete completely free from honeycombing 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 form work 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.

Hole 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 Engineer-in-charge 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 materials. 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 settled and treated with form oil approved by Engineer-in-charge. Lubricating (machine) oils shall not be used.

Oiling 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 positions.

Immediately before concreting is commenced the formworks 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 FORM WORK

Form works 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, the forms shall not be stripped in less than the minimum periods specified in IS: 456. Above period can be increased if 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 beam 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 unshared portion of the structure under construction, unless analysis indicates adequate strength to support such additional loads.

Form work 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.

5.7.1. HACKING:

Immediately after removal of forms, the concrete surface intended to be either plastered or finished, shall be roughened with brush hammer or with chisel and hammer as directed by the construction manager to make the surface sufficiently coarse and rough to provide a bonding key for plaster.

No extra payments shall be made to the Contractor for such work on concrete surface after removal of the form work.

No payment shall be made for temporary formwork used in concreting, or for form work required for joints or bulk-heads, in floor or elsewhere, whether such joints are to be covered later with concrete or mastic or other materials.

5.7.2. POCKETS AND OPENINGS:

Where boxes, pockets or openings are required (not exceeding 0.1 sqm) to be formed in the concrete. No deduction shall be made for the area of box or pockets in measuring the area of concrete surface shuttered. In other words the area of shuttering shall be reckoned as if box of pocket or openings were not present.

However, on measuring the concrete quantity, the volume of the box or pocket shall be deducted. If the area of box or pocket or openings against the shuttered faces exceeds 0.1 sqm. It shall be paid not as a box or pocket or opening but as formwork at the rates for formwork.

No extra payment shall be made for holes to be made in the form work for inserting electrical conduits hooks for fans etc.

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 has worn out and has become unfit for formwork. The Engineer-in-charge 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.
6 SPECIFICATIONS FOR BRICK MASONRY WORK:-

6.1 SCOPE:-

The Contractor shall provide all labour, materials, scaffolding operations, equipment and incidentals necessary required for the completion of all brickwork called for in the drawings and documents and that which is fairly intended for smooth completion of the work.

6.1.1 BRICKS (1st CLASS):-

The bricks shall be well burnt locally available from good brick earth and shall be of uniform size (9” x 4.5” x 3”) unless otherwise specified. They shall be of uniform deep red, cherry or copper colour, thoroughly well burnt without being verified and regular in shapes.

6.1.2 MORTARS:-

All brick work shall laid with specified mortar of good workable consistency.

6.1.3 SOAKING OF BRICKS:-

All bricks required for masonry in cement or composite lime mortars shall be thoroughly soaked in clean water for at least one hour in advance of sufficient size immediately before use. The cessation of bubbles when the bricks are immersed in water is an indication of thorough soaking of bricks.

6.1.4 LAYING:-

a) Bricks shall be laid in English bond, unless otherwise specified. Half or cut bricks shall not be used except where necessary to complete the bond. Closers in such cases shall be cut to the required size and used near the ends of the walls.

b) The walls shall be taken up truly plumb. All courses shall be laid truly horizontal and all vertical joints join shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. The thickness of brick courses shall be kept uniform and for this purpose straight edge with graduations showing the thickness of each brick course including joint shall be used. Bricks shall be laid with frogs upwards.

c) The walls of a structure shall be carried up regularly and nearly at one level and no portion of the work shall be left more than 3 ft. below the rest of the work. Where this is not possible the work shall be raked back according to bond (and not left toothed) at an angle not exceeding 45°.

d) All iron fixtures pipes, outlets of water, holdfasts of doors and windows, etc., which are required to be built in walls, shall be embedded in cement mortar or in cement concrete as specified, in their correct positions as the work proceeds. Nothing extra shall be paid for such extra cement mortar or of the nature stated above.

6.1.5. JOINTS:-

Bricks shall be so laid that all joints are quite full of mortar. The thickness of the bed joints shall in no case exceed 3/8”, unless otherwise specified. The face of joints shall be raked to a minimum depth of 0.5” by raking tool daily during the progress of work when the mortar is still green, so as to provide proper key for the plaster or pointing to be done. Where plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. The face of brick work shall be cleaned daily and all mortar droppings removed.
6.1.6 BRICK-IN-EDGE COPING

The top course of all plinths, parapets, steps and tops of walls below R.C.C. slabs or beams shall be laid with brick on edge, unless otherwise specified. Proper care shall be taken that the bricks forming the top corners and ends of walls shall be properly radiate and keyed in to position.

6.1.7. CURING:-

Green Work shall be protected from rain by suitable covering. Brick Masonry with cement or composite mortar shall be kept constantly moist on all faces for a minimum period of 7 (Seven) days. In case of fat lime mortar, curing shall commence two days after the laying of masonry and shall continue for 7 (seven) days.

6.1.8 SCAFFOLDING:

Double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong. Tied together with horizontal pieces over which the scaffolding planks shall be fixed. In building up to two stories, single scaffolding shall be allowed. In this case, the inner end of the horizontal scaffolding pole shall rest in a hole provided in the header course only. Only one header or each pole shall be left out. The holds left in masonry work for supporting the scaffoldings shall be filled and made good, before plastering. The Contractor shall be responsible for providing and maintaining sufficiently strong scaffolding so as to withstand all loads likely to come upon it.

6.2 HALF BRICK AND THREE INCH THICK MASONRY:-

6.2.1. The work shall be done exactly similar to the specification ‘BRICK WORK’ except that all courses shall be laid with stretchers.

6.2.2. Cement Mortar 1:4 (1 cement: 4 sand) shall be used unless otherwise specified in the description of the item.

6.2.3. The description of the item shall mention whether or not, reinforcement is to be provided, when the brick work is to be reinforced, hoop iron band 1” x 1/16” (2.5 c.m. x 1.6. mm) shall be embedded in the cement mortar at every fourth course or as described in the description of the item. The hoop iron shall be hooked (given a double lap) with minimum of 9” hooks at all angles and junctions. At either end of the wall, 2” (5 c.m.) lengths of the hoops shall be bent up or down so as to take a firm grip of the brick work. When hoop iron is not available equivalent reinforcement in the form of mild steel can be used after approval.

6.3 RUBBLE MASONRY:-

6.3.1. MATERIAL:-

The stones to be used for the masonry shall be hard, sound, free from cracks, flaws etc., and shall be from approved Quarries. They shall generally be freshly quarried with sharp edges and worn clean face. They shall be free from rounded, or weathered surfaces or skin or costing which prevents the adherence of mortar. Size & shape of stone shall be as per the requirement.

The stones to be used as headers, quoins, copings 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 colour. The beds and joints shall have an average bearing of not less than 2 cm. The quoins shall be of selected stone and shall normally be 10 cm. x 24 cm. x 39 cm. or as directed by Engineer-in-charge. The faces of quoins shall be rough tooled with 40 mm. chisel drafts at the corner edges. The beds and 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 opposite by more than 8 cm for the longer side and 60 m for the shorter side.
One through stone shall be provided per half sq m. of facing evenly distributed in a staggered pattern. They shall be about 0.03 sq m 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 wall a face to back. The length of the interior headers shall not be less than 45 cm & their average cross section area shall not be less than 0.025 sq m. Face header shall be distinctly marked on its face.

6.3.2 MORTAR:-

Unless otherwise mentioned the mortar for masonry work shall be composed of 1 part of cement and 5 parts of coarse approved sand the sand for mortar shall be as per IS 2116-1965.

6.3.3 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.

6.3.4 CONSTRUCTION:-

The masonry shall be laid to lines, levels, curve and shape as shown on the drawings, fixtures, plugs, brames, pipes conducts 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 tone

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 & 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 40mm, in faces where joints are to be pointed or struck and 12 mm. in faces proposed to be plastered. Quoins in the unexposed portions shall have the same facing as the rubble stones and shall have uniform chisel drafts of 40 mm. in the exposed portions and up to 15cm. below the finished ground level, quoins shall be rough tolled with 40 mm. chisel drafts at the corner edges.

v. The face stones shall be laid without any pinning on the exposed faces. In each course the headers or lines of headers as the case may be, shall kept in position as specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and intervals. They shall be embedded 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 fresh mortar. All stone shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet immediately on placement and solidly bedded in mortar before it is. Clean dips and 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 and beds necessary to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock, the face stones of the first course 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 levelled up by use of flat chips.

viii. VIII No face joints shall exceed 16 mm and the same shall be struck 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

xi. in plaster while plastering. The frames of doors, windows, cupboards, 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.

xii. 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 Engineer-in-charge 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.

xiii. 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 of 1 : 3 : 6 cement concrete and the face shall be finish with matching stones.

xiv. The top of masonry on which coping, R.C.C. slab or other flooring is to be laid shall be finished level or 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.

xv. The rate of raising uncoursed rubble masonry brought up in uniform levels may be limited to a height of 69 cm.

xvi. per day in case of cement mortar and 45 cm. in case of lime mortar.

xvii. All masonry work shall be kept well watered for 14 days after laying.

7. SPECIFICATION FOR DOORS & WINDOWS (WOOD WORK)

7.1 MATERIAL
7.1.1 TIMBER
7.1.1.1 TEAK WOOD
Teakwood shall be second class Indian Teakwood conforming to IS: 4021 of good quality, well seasoned and free from defects such as cracks, dead knots, sapwood etc. No individual and sound knot shall be more than 15 sq.cm in size and the aggregate area of such knots shall not exceed 2% of the areas of the piece. The timber shall be fairly close grained having not less than 2 growth rings per cm. Width in cross – section.

7.1.1.2 Hard Wood:
Hard wood shall be first class conforming to IS 4021 of good quality, well seasoned and free from defects such as Dead knots, cracks, sapwood etc. No individual hard and sound knot shall exceed 6 sq.cm in size with no dimension more than 50 mm and the aggregate area of such knots shall not be more than 1% of the area of the piece. There shall not be less than 5 growth rings per cm. Width in cross-section.

7.1.1.3 Moisture content in timber
The maximum permissible percentage of moisture content for well seasoned timber shall be as per IS 287.

7.1.1.4 Workmanship of wood work Workmanship for wood and joinery shall be as per IS 1200 and IS 4021.
7.1.1.5 Painting / Polishing of wood work

Painting / polishing of wood work shall be in accordance with clause Nos. of specification No.6.9.2 to 6.11.3.

7.2 WOODEN DOOR / WINDOW FRAME

Wooden door / window frame shall be made of specified wood as per item description and shall be in accordance with detailed drawings.

The wooden members of the frame shall be planed smooth and accurate to the full dimensions. Rebates, rounding, molding etc., shall be done before the members are jointed into frames.

Joints in the frame work shall be perfect with square edges and shall be pinned with hard wood / bamboo pins of 10 to 15 mm dia.

Wood work shall be painted / polished or otherwise treated as specified. All exposed portions shall be coated with wood primer and concealed surface by bituminous paints as per clause No. 6.

Before any surface treatment is applied, the wood work shall be got approved by the Engineer-in-charge. The frames shall be fixed only after acceptance by the Engineer-in-charge. The frames shall be fixed to the masonry by 300 mm x 25 mm x 6mm MS hold fasts embedded in M-15 grade concrete block of 350 mm x 100mm x 100 mm in the hole of the masonry. In case of concrete, frames shall be fixed by 96mm long 12 mm dia metallic dash fasteners.

7.3 SHUTTERS:

7.3.1. Particle Board flush shutter:
Particle board flush shutter shall in general conform to IS: 2202

7.3.1.1 Materials

7.3.1.1.1 Particle Board
Particle board shall conform to IS 3097 and shall be three layer flat pressed teak wood based and of exterior grade (Grade –1), type – 1, BWP type, bonded with phenol Formaldehyde synthetic resin conforming to IS: 848.

7.3.1.1.2 Veneers
Veneers shall conform to class – 1 of IS 303 and (BS 476 Part – 7)

7.3.1.1.3 Teak wood
Specification of Teak wood shall same as specified in clause 9.1.1.1

7.3.1.1.4 Hinges

Hinges shall be of brass and butt type conforming to IS: 205. Size of hinges shall be in accordance with shutter width and as per IS: 205.

7.3.1.2 Workmanship

The particle board of required size and thickness shall be lipped on all the edges with T-type, teak wood lipping. The overall board lapping composition shall be uniform and specified thickness and shall be properly sized in view of the operation of shutter.

All the four edges of the door shutter shall be square. The shutter shall be free from twist or warp in its plane. In case of double leaf shutters, the meeting of the stiles shall be rebated by one third the thickness of shutter. The rebating shall be splayed.
The shutter then shall be veneered on both faces by gluing approved shade and textured commercial type 0.5 mm thick veneering conforming to class 1 of IS 303.

The veneering shall be done by gluing the veneer with BWP type, phenol formaldehyde synthetic resin conforming to IS 848 by not press process on the shutter. Workmanship and finish of the veneering shall conform to IS 303.

The shutter shall be fixed to the door frame, by means of hinges @ minimum 3 hinges per leaf, maximum spacing of hinges being 600 mm or as per drawing with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame etc.

7.3.2 Glazed Wooden Door shutter

7.3.2.1 Materials

7.3.2.1.1 Wood

Teakwood for various members like stiles, rails etc., shall be as specified in clause No.9.1.1.1.

7.3.2.1.3 WORKMANSHIP

Teakwood stiles and rails of size as specified in item description shall be cut accurately and planned smoothly to required dimensions as per drawings. The stiles and rails shall be provided with rebates for fixing the glazing and shall be joined together to form the profile of the shutter as per drawings. The joinery work shall be as approved by Engineer-in-charge. Only after such approval, the joints shall be coated with white lead, pressed and secured by hardwood pins of about 6 mm dia. All the four edges of the shutter shall be square. In case of double leaf doors, rebates shall be provided at the meeting of stiles. Rebates shall be splayed type and one third the thickness of the stiles.

The glass sheets for glazing shall be fixed by teak wood beading having mitered joints as per drawings and shall be fixed by means of approved neoprene based adhesive and nailing, the spacing between the nails being no more than 300 mm.

All wooden surfaces shall be coated with 2 coats of approved make polyurethane with Steiner mixed to achieve desired shade.

The shutter shall be fixed to the door frame, by means of hinge @ minimum 3 hinges per leaf, maximum spacing of hinges being 600 mm or as per drawing with suitable sized screws.

The shutter when fitted to the frame shall satisfy all operational aspects of the door like smooth movement, proper closing against the door frame etc.

7.4 Aluminum Glazed Doors / Windows / Ventilators

7.4.1 General
Aluminum glazed doors / windows / ventilators shall be of specified sectional size, dimension and profile as per drawings.

7.4.2 Materials
All Aluminum sections shall be extruded sections of aluminum alloy as per IS:733 and IS:1285. Aluminum sections shall be anodized as per IS: 7088 to min, 25 microns.
Glass used for glazing shall be of following type in accordance with item description.

i. 5.5 mm thick wired glass conforming to IS 5437.
ii. 6.3 mm thick laminated safety glass conforming to IS 2553.
iii. 5.5 mm thick transparent sheet glass conforming to IS: 2853 (Wt. 7.2 kg/sqm).

7.4.3 Workmanship
Frames shall be square and flat, the corner of the frame being fabricated to true right angles. Details of construction of frames, shutters etc., shall be as per drawings.

Side hung window shutters shall either be fixed to the frame with pivots, or aluminum alloy hinges. For fixing the hinges, slots shall be cut in the fixed frames and the hinges inserted inside may be riveted to the frame. The hinges shall normally be of the projecting type conforming to IS designation A-5-M of IS – 617, IS 733. In which case peg stay of 300 mm long complete with locking bracket and conforming to IS codes same as for hinges shall be provided. Friction hinges may also be provided in which case peg stays are not required.
The handles for side hung shutters shall be of cast aluminum conforming to IS designation A-5-M of IS 617 and shall be mounted on a handle plate riveted to the opening frames. The handle shall have anodized finish with minimum anodic film thickness of 25 micron of Electro colour finish. The handle shall have a two point nose which shall engage with an aluminum striking plate on the fixed frame. The striking plate shall be finished in the same manner as for the handle.

In case of top hung shutters, aluminum alloy cast hinges and peg stays (same as per side hung shutters) shall be provided.
Center hung shutters shall be hung on the two pairs of cup pivots of aluminum alloy of IS designation NS – 4 of IS 737 and IS designation A-5-M of IS 617 or cadmium plated brass / bronze cup pivots riveted to the outer and inner frames to permit to swing through an angle of 850. Cast aluminum (conforming to IS designation A-5-M of IS 617) or chromium / cadmium plated bronze spring catches shall be fitted in the centre of the top bar of the shutter. The spring catch shall be secured to the frame by screwing / riveting to the frame and shall close into and aluminum catch plate riveted / welded to the outside of the outer shutter frame bar.

Aluminum or cadmium plated brass chord pulley wheel in an aluminum bracket shall be fitted at the sill of the shutter with Aluminum or galvanized / cadmium plated steel screws. The door shutters shall be fitted with pivots as specified. The handle for doors shall be of aluminum and as per design. The door shutters shall be provided with locking device, floor spring, O/H door closer and any other hard wares, specified in item.
In case of composite Door / window / ventilator units shall be coupled as per drawing. Weather bar shall be provided whenever a coupling member is fitted over an external opening shutter.

Glazing shall be fixed to the extruded sections by means of extruded aluminum beading. Glass panes shall be provided with rubber lining before fixing. The aluminum frames shall be fixed to the masonry by means of aluminum lugs fixed to the frame (by counter sunk galvanized machine screws) and grouted with M-15 grade concrete in the hole in the masonry as per drawing. In case of concrete wall, the frames shall be fixed by 96 mm long, 12 mm dia metallic dash fasteners. Any steel material coming in contact with aluminum shall be galvanized.
The windows / ventilators / doors shall be checked to ensure smooth operation, perfect level and plumb.

FIRE DOORS & FITTINGS
All work is to be carried out in accordance with respective IS Code and specification for Fire Door & fitting as per IS: 3614 (Part 1) - 1966

Fully insulated 55 mm thick wooden fire / smoke check door shutter using 31mm thick FR insulation with internal facia of 9mm thick calcium silicate board having density not less than 950 Kg/cum on both sides and faced with 4mm thick commercial ply facing including 15X55 mm size hardwood beading with fire and smoke seal of size 10 X 4 mm fitted along vertical and horizontal edges of the shutter .The complete door system...
should be capable to achieve Two hour fire rating in accordance with BS:476 Part 20and IS:3614 part II.Rate to include 150x75mm Hardwood door frame duly embedded with Prom seal Intumescing Smoke Strip as per manufacturer's specification all complete. The door shutter shall also have a vision panel 6mm thick, 200mm x 300mm / 300mm x 300mm fire rated glass, surrounded with fire proof treated teakwood beading, all around complete in all respects as per manufactures specifications and direction of Engineer in charge.

8. SPECIFICATION FOR FLOORING & PAVING

8.1 SCOPE

The Contractor shall furnish all labour, materials, tools, equipment, machinery operations and related items necessary and required for the full performance of the contract under this section, as shown on the drawings or as specified or reasonably implied or incidental to the construction.

8.2 GENERAL

The flooring shall be laid to the level except where slopes are called for on the drawings, in which case the slopes shall be uniform and arranged to drain into the indicated outlets. Particular care shall be exercised to ensure that all flooring, skirting etc., is perfectly matched for color and finish. The Contractor shall pave the areas indicated on the plans and schedule of finishes with materials therein called for. All work shall be laid to the best practice known to the trade.

The Contractor shall furnish for approval, samples of each type of floor, paving etc., the samples shall be of sizes and thickness as specified.

8.3 POLISHED GRANITE STONE SLABS FOR FLOORING, STEPS, STAIRS, CLADDING ON PANTRY AND WASH BASIN COUNTERS

Providing & fixing granite of approved quality and colour of required size mm double polished M/C cut of 20mm thick over floor surface in proper line. Level in CM 1:4 including finishing the joint with matching colour cement, polishing the top surface etc., complete as per instruction of EIC.

Granite stone shall be of best quality machine polished, Machine Cut and of approved colour, dense and homogenous in texture free from cracks, decay, weathering and flaws. The stone shall be of required size and shall be 20 mm thick. The material shall have to be got approved before and after procurement. Before laying flooring, the surface shall be paved and thoroughly hacked, cleaned off all mortar scales, loose materials etc., unless and until the surface is approved ready for paving, the laying shall not be done. The bedding with CM 1:4 proportions as directed with minimum thickness of 30 mm layer shall be laid evenly and to the required slope. The granite shall be truly and evenly set in thin paste of next cement apply to the bottom and to the prepared base. The stone then shall be tempted down with wooden mallet until they are exactly in true plane and in line with adjacent stone.

The stone shall be closed jointed and filled with matching cement. The entire surface of flooring shall be polished with machine up to mirror polish achieved including necessary use of antimony trioxide anxilix acid etc., as directed

8.4.1 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 troweling 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.

8.4.2 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 gunnies shall be avoided as the color is likely to be bleached with the remnants of cement matter from the bags.
9 CERAMIC TILES GLAZED AND MATT FINISH
Ceramic tiles in toilets and other areas where called for shall be non-slip ceramic tiles of approved make and shade. The tiles shall be laid to the pattern as approved. The tiles shall be of uniform color, true to size and shape and free from cracks, twists, uneven edges, crazing and other defects. The size and thickness of the tiles shall be as specified. The tiles shall be laid as per the pattern shown in the drawings over a bed of specified thickness of cement mortar leveled to a true surface. The surface of the bedding mortar shall be left rough to provide bond for the tiles. A floating coat of thick cement slurry shall be laid over the screed to proper levels and the tiles set over the same firmly to correct line and levels.

The joints shall be filled and finished neat with cement paste pigmented to the shade of the tile. The joints shall be finished neat as directed and shall be straight, regular and uniform. On completion, the surface shall be washed with water, rubbed with fine saw dust and left clean. The finished floor surface shall be true to required levels.

9.1 VTRIFIED TILES IN FLOORING AND SKIRTING

9.1.1. VITRIFIED TILES
The tiles shall generally conform to latest IS standards 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 specified size and thickness as per drawing. The tolerance on facial dimension value shall be +/- 1.0mm and +/- 0.5 mm in thickness.

The top surface of the tiles shall be glazed. The glazed shall be either glossy or matt as specified. The underside of the tiles shall be completely free glazed in order that the tile may adhere properly to the base. Type edges of the tiles shall be preferably free form glaze, however, and glazed if unavoidable, shall be permissible on any one edge of the tile.

9.1.2 LAYING
The Vitrified tiles shall be laid over ferrow 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, pissed tapped, with a wooden mallet, and brought to required level the tiles shall be laid as per the pattern shown on the drawings or as approved.

It shall then be removed and laid a side. The top of the mortar shall then by corrected by adding fresh mortar at hollows. The mortar is then allowed to harden and cement slurry of paste like consistency shall be spread over the same at the rate of 1 bag per sqmt. area. The edges of the tile already laid shall be buttered with slurry of cement and pigment to match the shade of slabs. The tile to be laid shall then be placed back in position, pressed and properly bedded in level with adjoining tiles with as fine a joint as possible. Other tiles are also laid in similar manner to correct levels with fine joints. The surplus slurry on the surface shall be cleaned off.

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. Where full size tiles cannot be fixed these shall be cut to the required size and their edges rubbed smooth.

9.1.3 CURING AND FINISHING
The joints shall be cleaned off of the grey cement grout with soft wire brush or trowel to a depth of 2mm to 3mm and all dust and loose mortar removed Joints shall then be flush pointed with white cement added with pigment if required to match the color of tiles. The surface shall then be kept wet for 7 days.

After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with wooden mallet.
10 WATER-PROOFING FOR ROOF
The waterproofing shall be integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc. consisting of following operations:

a) Applying and grouting a slurry coat of neat cement using 2.75 kg/sqm. of cement admixed with proprietary water proofing compound conforming to IS: 2645 over the RCC slab including cleaning the surface before treatment.

b) Laying cement concrete using broken bricks/brick bats 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of mix 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls up to 300mm height including rounding of junctions of walls and slabs.

c) After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.

d) Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300mm square.

e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-Charge.

With average thickness of 120mm & minimum thickness at Khurras as 65mm.

10.1 GUARANTEE
The treatment shall carry a guarantee for 10 years against leakage of water, dampness, seating and other defects. The treated roof shall be tested by allowing water to stand on the areas to a depth of 150 mm for at least 72 hours.

All guarantees shall be furnished in the format approved /Engineer-in-charge duly signed by the contractor and sub contractor.

10.2 SPECIFICATIONS FOR CURING
The finished surface shall be cured for at least 7 days

10.3 KHURRAS
The Khurras shall be constructed before the brick masonry work in parapet wall is taken up, and it shall be 45 cm x 45 cm and shall be formed of cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) unless otherwise specified in the drawings.

10.4 LAYING
A PVC sheet 1M X 1M X 400 micron shall be laid under the khurras and then cement concrete shall be laid over it to a minimum thickness of 3 cm with its top surface lower than the level of adjoining roof surface as approved.

10.5 FINISHING
The Khurras and sides of the outlet shall then be rendered with cement plaster of mix and thickness stipulated in the drawings. This shall be done when the concrete is still green and shall be finished with a floating coat of neat cement The sides of the Khurras and sizes of finished outlet opening shall be as directed .

11 SPECIFICATIONS FOR PLASTERING WORK
11.1 SCOPE
The Contractor shall furnish all labour, materials scaffolding, equipment, tools, plants and incidentals necessary and required for the completion of all plaster work.

11.2 GENERAL
Plaster as herein specified shall be applied to all internal surface where called for. All plaster work shall be executed by skilled workmen in a workman like manner and shall be of the best workmanship.

The primary requirement of plaster work shall be to provide dense, smooth and hard enclosure and devoid of any cracks of the interior and/or exterior.

11.3 SCAFFOLDING
Double scaffolding having two seats 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.

11.4 CHASING AND BREAKAGE
Fixing of door and window frame shall be completed before any plaster work is commenced on 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 before cutting any such plaster. Broken corners shall be obtained before cutting any such plaster; broken corners shall be cut back out less than 150 mm on sides and patched with cement mortar as directed. All corners shall be rounded to a radius of 80 mm or as directed.

11.5 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 scrapping. For masonry surfaces the joints shall be raked out properly, while the concrete surfaces shall be roughed by wire brushing and hacking to provide the key, thereby ensuring proper bond. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced.

11.6 CHICKEN WIRE MESH
Galvanized chicken mesh (22 gauge, 12 mm 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 of the mesh. The width of the mesh shall be as approved by the Engineer-in-charge. The chicken mesh wherever specified, shall be fixed in place before plastering.

11.7 Samples of each type of plaster shall be prepared well in advance of undertaking the work for the approval.

11.8 MORTAR
The mortar of the specified mix shall be used. Mortar shall be prepared as specified under “Concrete Work”. It shall be made in small quantities, as required, and applied within 15 minutes of adding water to the plaster mix

11.8.1 CEMENT:
Cement shall be as per specifications under “Concrete Work”

11.8.2 WATER:
Water shall be as per specifications under “Concrete Work”

11.8.3 SAND
For plaster work normally clean fine river 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 river sand in proportion specified or directed.

11.8.4 WATER PROOFING COMPOUND

Chemicals as approved.

11.9. PLASTER

6mm thick plaster shall be completed before commencement of wall plaster. Plastering shall be started from the top and worked down towards the floor. To ensure even thickness and true 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 the plaster to serve as gauges. The surface of these gauged areas shall be truly in place 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 side movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive trawling 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 any 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 late on. Grooves shall be provided at the junction of Ceiling and wall plaster without any extra cost. In suspending work at the end of the day, plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scraped, cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to be properly joined together. Plastering work shall be closed at the end a of 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. Horizontal joints in plaster work shall not also occur on parapet tops and copings, as these invariably lead to leakages.

11.9.1 GROOVES

Wherever directed all joints between concrete and brick masonry besides other locations as called for shall be expressed by a groove cut in plaster at no extra cost

11.9.2 FINISH

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m 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.

11.9.3 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 at least 7 days. During this period, it shall be suitably Protected from all damages

11.9.4 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

11.9.5 FLOATING COAT OF NEAT CEMENT
Where finishing with a floating coat of neat cement is specified in the drawings or directed, specification, for this item of work shall be same 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 quantity of cement applied for floating coat shall 1 kg. per sq. mt. smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

11.10 BEARING PLASTER

This shall be consist of cement plaster 1:3(1 cement : 3 coarse sand) 20 mm thick finished with a coat neat cement laid on top of walls as bearing for RCC lintels, beams and slabs. When dry, a thick coat of lime wash shall be given.

12. SPECIFICATION FOR PAINTING WORK

12.1 OIL BOUND DISTEMPER

12.1.1 MATERIALS

Oil emulsion (Oil Bound) washable distemper (IS : 428) of approved brand and manufacture shall be used. The primer shall be of the same manufacture as distemper shall be diluted with water of any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day’s work shall be prepared.

The distemper and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight’s work, and the same shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed / Engineer-in-Charge.

12.1.2 PREPARATION OF SURFACE

The surface shall be thoroughly cleaned of dust. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulations and then sandpapering the same after it is dry.

Pitting in plaster shall be made good with plaster of Paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

12.1.3 APPLICATION

15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

12.1.4 SCAFFOLDING

The specifications in respect of scaffolding, protective measures shall be as described under white washing.

12.2 WATER PROOF CEMENT PAINT

12.2.1 MATERIAL

Cement paint of required colour and of approved brand and manufacture conforming to IS : 5410 shall be used. Before application of the cement paint the shade shall be got approved. Cement paint shall be mixed with water...
in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care 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 become air set due to its hygroscopic qualities.

12.2.2 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.

12.2.3 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 on even colour. 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 room at a time The application of a coat in each room shall be finished in one operation and no work shall be started in any room, 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 painting shall not be used.

12.2.4 SCAFFOLDING

The specifications in respect to 12.1.1 scaffolding protective measures shall be as described above under white washing.

13. SPECIFICATIONS FOR ACRYLIC EMULSION PAINTING:

13.1 Workmanship:

13.1.1 Scaffolding:

Wherever scaffolding is necessary, it shall be erected on double supports ties together by horizontal pieces, over which scaffolding planks will 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.

13.1.2 Preparation of surface:

Preparation of surface shall in general be in accordance with, except that any unevenness shall be made good by applying putty (white cement based) mixed with water including up the undulation and then sand papering the same after it is dry.

13.1.3 Preparation of paint

The paint mix, shall be continuously stirred while applying for maintaining uniform consistency. Number of coats shall be as per item description. The painting shall be laid evenly and smoothly by means of crossing and lying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard at first,
then brushing alternatively in opposite direction 2/3 times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks, no hair marks no clogging of paint puddles shall be permitted. The full process of crossing and laying off with constitute one coat.

The paint shall be applied by means of brush or roller.

Before starting painting with plastic emulsion paint, the prepared surface shall be reacts with two coats of primer consisting of cement primer whiting and plastic emulsion paint shall start only after the preceding coat has become sufficiently hard to resist brush marking. Subsequent coats of plastic emulsion paint shall also be started after the preceding coat is dried by evaporation of water content.

The surface of finishing shall present a flat, velvets smooth finish, even and uniform shade without patches, marks, paint drops etc.

13.1.4 Precautions:

i. Brushes shall be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush. Old brushes, if used shall be completely dried of turpentine / oil paints by washing in warm soap water.

ii. No oil base puttied shall be used in filling cracks / holes.

iii. Washing of painted surface shall not be done within 3-4 weeks of application.

13.1.5 Protective measures

Surface of distempering over existing distempered surface, the existing distempering shall be scrapped by steel scrapers leaving a clean surface.

All nails shall be removed. Pitting in plaster shall be made good with plaster of paris mixed with dry distemper of colour to be used. The surface then shall be rubbed down again with a fine grade sand paper and made smooth. A coat of distemper shall be applied over the patches. The surface shall be allowed to dry thoroughly before the regular coat of distemper is allowed.

The surface affected by moss, fungus, algae efflorescence shall be treated in accordance with IS 2395.

**13.2 ACRYLIC COPOLYMER AGGREGATE FINISH**

13.2.1 Material

It shall be an acrylic based textured wall coating consisting of quartz and silica aggregate, inorganic pigments and other additives to form a crack free, flexible, tough, water proof coating.

13.2.2 Preparation of Surface

The surface to be coated shall be cleaned and all dirt, dust, grease and loose particles shall be removed. Any old textures surface shall be removed with removing agent as per manufacturer’s instructions.

13.2.3 Application

Bonding agent and water shall be mixed first. Then the flakes / granules shall be added and mixed thoroughly and kneaded till no lumps are found. The dough shall be left for 20-30 minutes before starting application. The bonding agent flakes / granules and water shall be mixed in different ratios for different finishes as per manufacturer’s specifications.

The first application shall be by steel trowel. It shall be smoothened, if the specified finish required, by a plastic trowel.
13.3 VARNISHING

Varnishing of wood and wood based material shall be in accordance with IS 2338 (Part – II). Surface to be varnished shall be prepared to produce a smooth, dry and matt surface and all dust and dirt shall be removed from the surface.

The varnish shall be applied liberally with a bush and spread evenly over a portion of the surface with short light strokes to avoid fronting. It shall be allowed to flow out while the next section is being laid in. Excess, varnish shall be scraped out of the brush and then the first section be crossed, re crossed and laid off lightly. The varnish, once it has begun to set, shall not be retouched. In case of any mistake, the Varnish shall be removed and the work shall be started afresh.

Where two coats of varnish are applied, the first coat shall be hard drying under coating or flating varnish which shall be allowed to dry hard and then be flatted down before applying the finishing coat. Sufficient time shall be allowed in between two coats.

When flat varnishing is used for finishing, a preparatory coat of hard drying under coating of flating varnish shall first be applied and shall be allowed to harden thoroughly. It shall then be lightly rubbed down before the flat varnish is applied.

On larger areas, the flat varnish shall be applied rapidly, and the edges of each patch applied shall not be allowed to set, but shall be followed up whilst in free working conditions.

13.3.1 French polish

French polish shall conform to IS: 348. Suitable pigments shall be added to get the required colour. The surface to be French polished shall be rubbed down to smoothness with sand paper and shall be well dusted. Pores in the surface shall be filled up with fillers. A pad of woolen cloth covered by a fine cloth shall be used to apply the finish. The pad shall be moistened with polish and rubbed hard on the surface in a series of over lapping circles applying the polish sparingly but uniformly over the entire area to give an even surface. A trace of linseed oil may be used on the face of the pad for the purpose. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

13.4 PAINTING OF STEEL AND OTHER METAL SURFACES

13.4.1 GENERAL

Reference shall be made to the following Indian Standards: IS 2524, IS 1447.

13.4.2 Preparation of surface

The surface, before painting, shall be cleaned of all rust, scale, dirt and other foreign matter with wire brushes, steel wool, scrapers, sand paper etc. The surface shall then be wiped finally with mineral turpentine which shall then be removed of grease etc. The surface then shall be allowed to dry. In case of GI surface so prepared shall be treated with Mordant solution (5 liters for about 100 sq.m) by rubbing the solution generously with brush. After about half an hour, the surface if required shall be retouched and washed down thoroughly with clean cold water & allowed to dry.

13.4.3 Application of priming and paints

Approved quality primer and paint in specified no. of coats shall be applied as per manufacturer’s recommendations either by brushing or spraying. Each subsequent coat shall be applied only after the preceding coat is dried.
13.5 SYNTHETIC ENAMEL PAINT TO WOOD WORK

13.5.1 Synthetic enamel paint of approved brand and manufacture and of the required colour shall be used for the top coat and an under coat of shade to match the top coat as recommended by the manufacture shall be used.

13.5.2 One coat of specified paint of shade suited to the shade of the top coat shall be applied after rubbing with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dust off.

13.5.3 Top coats of specified paint of required shade shall be applied after the first coat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

GRID FALSE CEILING SYSTEMS
ALUMINIUM GRID SYSTEM

Aluminum grid system for supporting false Ceiling tiles shall be of approved made and shall be perfectly leveled aligned at desired height and in accordance with the false Ceiling pattern as per drawings.

MATERIAL

a. Main Runner shall be of extruded anodized (25 micron) aluminum Tee sections of 25mm x 35mm size (approved make), 2.5 mm thick.

ERECITION

The grid system shall be assembled by interlocking the main and cross runners @ 600 mm c/c max. on both ways by means of aluminum angle cleats. The main runners shall be suspended from the Ceiling by means of 3 mm thick MS flat clamp fixed to main runners @ 1200 mm max. and fixed to 6 mm dia MS hook which again is fixed to the Ceiling. 3 mm thick MS flat clamp shall be connected to main runner with 25 mm long MS clamp with leveling nut and @ 1200 mm maximum. The MS hooks shall be suspended from the Ceiling by means of slotting in 25mm x 3mm thick MS flat, ‘L’ shaped, fixed to the slab by 12 mm dia Dash fasteners @ 1200 mm C/C. The overall grid system shall be rigid, in accordance with false Ceiling pattern, perfectly leveled and aligned at desirable height.

GI GRID SYSTEM

GI grid system for supporting false Ceiling tiles shall be perfectly leveled, aligned at desired height in accordance with false Ceiling pattern.

MATERIAL AND WORKMANSHIP

a. Wall Channels
Wall channels shall be made 0.5 mm thick GI of size 27 mm, one flange 20 mm and other 30 mm. Wall channels shall be fixed to peripheral walls by raw plugs / dash fasteners @ 450 mm C/C.

b. Intermediate Channels (main runners)
GI intermediate channels shall be 0.9 mm thick, of size 45 mm and with two flanges of 15 mm each. The intermediate channels shall be suspended from the soft @ 1200 mm with 25 mm x 0.5 mm GI hanger bolted to the channel and fixed to the Ceiling (by means of bolting to GI cleat fixed to the Ceiling with dash fasteners).

c. Sections (Cross runners)
GI channel shaped Ceiling sections shall be 0.5 mm thick having a knurled Web of 51.1 mm and two flanges of 26 mm each with lips of 10.5 mm. The Ceiling sections shall be fixed to the intermediate channels in perpendicular direction at 450 mm C/C with the help of connecting clips.
1.2 GYPSUM BOARD TILES:

Gypsum board shall conform to IS: 2095 The Gypsum boards used for false Ceiling shall have following properties

i Thermal Conductivity – 0.16 W / mk

ii Thermal Resistance
   a. For 9.5 mm thick board – 0.06 m² K/W
   b. For 12.5 mm thick board – 0.08 m² K/W
   c. For 15 mm thick board – 0.09 m² K/W

iii Fire Propagation
   a. Fire Propagation
      Index of performance not exceeding 12 and a sub index not exceeding 6 (when each side is tested separately to BS 476 Part – 6).
   b. Surface spread of flame Class 1 (both sides) as / test to BS 476 Part – 7).

Gypsum boards shall be specified thickness, and of specified finish (painted / prelaminated). The Gypsum boards shall be screw fixed to the underside of false Ceiling grid system with 12.5 mm dry wall screw @ 230 mm C/C by drilling machine. Joint in the board shall be finished flush with fillers, finisher and primer as per manufacturer’s recommendation to give seamless finish.

Necessary cut-outs for Electrical / AC and other fixtures shall be provided with a framing of wall channels.

The finished false Ceiling shall be perfectly leveled and aligned, at desired height as per drawings.

Acoustical Ceiling

System Description
Standard Panels: - Suspended (New Fire-Rated) ceiling system consisting of acoustical panel ceiling suspension system as per ISO-4611. System shall be rated NRC (Noise Reduction Coefficient) in accordance with ASTM-E-84 as tested by an independent agency.

CAC : Ceiling Attenuation Class
LR : Light Reflectance Coefficient
NRC : Noise Reduction Coefficient

Delivery & Storage of Material
All material shall be delivered in their original unopened packages and stored in an enclosed shelter providing protection from damage and exposure to the elements.

Storage time of material at jobsite should be as short as possible and environmental conditions should be as near as possible to those specified for occupancy. Excess humidity during storage can cause expansion of material and possible warp, sag, or poor fit after installation.

Damaged or deteriorated materials should be removed from the premises. Immediately before installation, to stabilize tile and panels, store them at a location where temperature and humidity conditions duplicate those ambient during installation and anticipated for occupancy.

Environmental Condition:-
Installation of acoustic panels shall not begin until building is enclosed, permanent heating and cooling equipments is in operation, and residual moisture from plaster, concrete, or terrazzo work has dissipated.

Do not use ceiling panels in extreme of continuous high humidity, or areas exposed directly to weather or water. Ceiling panels are fixed and designed for use within the standard occupancy range of temperature and humidity 65-85°F (18-29°C), no more than 70% RH (Relative Humidity).
Humidity can greatly affect product dimensional ability and sag resistance. Sag can become noticeable during periods of high humidity lasting on a few hours. Allow time for dimensional changes in ceiling panels stored at temperature/humidity condition well outside of those recommended for service. With increase on temperature and humidity, these products expand 1/64 in./ft (4.3 mm/m) at 85°F (29°C)/90% RH and may not fit into a fix grid. Conversely, with decrease these products will be undersized but expand to normal when ambient conditions return. For some pattern as detail, if perimeter panels must be cut smaller, the cut must be filled-rebated, or the wall angle must be lowered by (1/4") (3/8") Reveal depth.

Quality Assurance
Single source responsibility: to obtain life time ceiling system warranty, 30-years ceiling system warranty, colour match or ceiling panel and suspension system compatibility should be preferred. Installer shall have successful experience in installation of suspended ceiling system on project with requirement specified. Manufacturer will provide test certification for minimum requirements as tested in accordance with applicable industry standards and/or to meet performance standard specified by various agencies. System performance following any substitution of materials or change in assembly design must be certified by the manufacturer.

Submittals
1. Reflected ceiling plans: Contractor shall submit a layout arrangement of ceiling design, dimensions and location of related integrated lighting and air distribution components.
2. Detail complete installation including suspension system, installation of related lighting and air distribution components, access requirements, sound absorption requirements, and fire rating requirements when applicable.
3. Submit manufacturer’s catalog cuts of standards drawings showing detail of system with project conditions clearly identified and manufacture’s recommended installation instructions.
4. 1% of amount of ceiling components installed.

Acoustical Wall Panel Specification for Standard Wall Panel
GENERAL
Contractor shall submit Shop Drawings showing fabrication and installation details for acoustical Wall panels, including plans, elevations, sections, details and attachment of other work. Submittals: Furnish 12”x12” samples, showing manufacture full range of colors, texture and patterns available for each type of acoustical product specified.

Product Test Report: From a qualified testing agency indicating wall panels comply with requirements.

Qualification Data: For firms specified in “Quality Assurance” Article to demonstrate their capabilities and experience.

Product Certificates: Signed by manufacturer certifying that the products Furnished comply with requirements.

Manufacturer Qualification: Manufacture shall have a minimum of 5 years experience in production of specified products and shall furnish supporting documentation showing completed jobs of approximately the same size and scope.

Fire Test Reports: Provide acoustical wall panels with the following surface-burning characteristics as per ASTM E 84.
1. Flame Spread: 25 or less
2. Smoke Developed: 450 or less

Acoustical Test Report: Provide acoustical test report from a qualified testing agency.

DELIVERY, STORAGE, AND HANDLING
Protect Acoustical Wall Panels from excessive moisture when shipping, storing, and handling. Deliver in unopened skids and store in a dry place with adequate air circulation. Do not deliver material until all wet-work has been completed.

WALL PANELS, GENERAL

Acoustical Wall Panels shall be (5/8"-1”-1 1/2"-2” or custom)-6.0-7.0 lb. per cubic foot high-density fine fibered fiberglass. Manufactures standard panel construction, fully wrapped, hardened, panel manufactures standard full line of fabric.
Facing Material: Guilford of Maine FR 701 –Style 2100 -100% Polyester
Panel Thickness: (5/8”, 1”,1 1/2”,2”) see above
Noise Reduction Coefficient: (.55-.80-.90-1.00)
Panel Width: As indicated, up to 60” width maximum
Panel Length: As indicated, up to 10 feet long

CONSTRUCTION

The acoustical wall panel product shall be supplied in widths and lengths as indicated. All edges will be fully wrapped with mounting as indicated

MOUNTING

Back-Mounting Accessories: Manufactures standard accessories for securely mounting panels, of type and size indicated and complying with the following requirements:

1. Mechanically Mounted Edge-Reinforced Panels: Metal impaling clips designed to support weight of panels, mechanically attached to wall substrate according to manufactures standard pattern and Adhesively bonded to back of panel, with base support brackets where recommended by manufacture for additional support of panels.

FLAMMABILITY RATING

All components shall have a Class a Flammability rating per ASTM E-84: Surface Burning Characteristics of Building Materials, with a Flame Spread of 25 or less and Smoke Developed of 450 or less.

INSTALLATION

Install Acoustical Wall panels in locations indicated top edges level and in alignment with other panels. Comply with manufactures written Instructions for installation of panels using type of mounting accessories indicated or, if not indicated, as recommended by manufacture

CLEANING

After completion of installation of panels, remove dust and other foreign material according to manufactures written instructions. Remove surplus material, rubbish, and debris resulting from panel Installation, on completion of the work, and leave areas of installation in a neat and clean condition.

GRC Technical Specifications

Work Includes :-

| a) Providing and Fixing of G.R.C. Band of approved Pattern of Following Sizes as per Drawing and direction of Engineer in charge |
|---|---|
| For 300 mm width & 250 mm depth |
| For 250 mm width & 250 mm depth |
| For 200 mm width & 250 mm depth |
| b) Providing and fixing of GRC Crown of approved Pattern of Following Sizes as per Drawing and direction of Engineer in charge |
| 300x1000x300 mm |
c) Providing and fixing of GRC designed at columns base and loop as per Drawing and direction of Engineer-in-Charge

200 x 750 x 300 mm
150 x 600 x 300 mm

<table>
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<tr>
<th>1400 mm dia</th>
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<td>1000 mm dia</td>
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</table>

d) Providing and Fixing Of GRC Designed Moulding Of approved Design & Pattern as per Drawing and Direction of Engineer in Encharge

| 1350 x 250 mm |
| 1300 x 150 mm |
| 1650 x 250 mm |
| 1600 x 150 mm |

Dry Density : > 1800 kg/m3
Water Absorption : Less than 6% of dry weight by immersion over a period of 24 hours.
Compressive Strength : > 400 Kg. / CM2 (M - 40 Grade)
Wet Transverse Strength : > 7 N/ mm
Abrasion Resistance : Less than 2.0 for E.H.D.
Thermal Conductivity : 1.63 W/MK at 3% moisture content
1.80 W/MK at 5% moisture content

**MARBLE FLOORING**

i) **Marble Slabs:** The marble shall be of approved shade and sources as mentioned in the Schedule of Quantities and their size and the thickness shall be as shown in the drawings and as approved by the Architect. They shall be of selected quality, dense, uniform and homogeneous in texture and free from cracks or other structural defects. It shall have even and crystalline grains. The surface shall be machine polished to an even and perfectly plain surface and edges machine cut true and square. The rear face shall be rough enough to provide a key for the mortar. No slab shall be thinner than the specified thickness at its thinnest part. The dimensions of the slabs shall be as specified. A few approved samples of finished slabs to be used shall be deposited by the contractor in the office of the EIC.

ii) **Mortar Bedding:** Cement mortar for bedding may be mixed manually or by a mechanical mixer as directed. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Care shall be taken in preparing the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stones. Before spreading the mortar, sub-floor or base shall be cleaned of all dirt, scum or laitance and of loose materials and then well wetted without forming any pools of water on the surface. In case of R.C.C. floors, the top shall be left a little rough. All points of level for the finished paving surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with slabs within half an hour. The thickness of the mortar bedding shall be 50mm avg. thick (But not less than 20 mm thick). The proportion of mortar bedding shall be 1:4 cement mortars.

iii) **Laying Marble Slabs:**

Before laying, marble shall be thoroughly wetted with clean water. Neat cement grout of honey like consistency shall be spread on the mortar bed over as much area as could be covered with the slabs within half an hour. The specified type of marble slabs shall be laid to pattern as directed on the neat cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each slab shall be gently tapped with a wooden mallet till it is firmly and properly bedded. There shall be no hollows left. If there is a hollow sound or gentle tapping on the slabs, such slabs shall be removed and reset properly. The joints shall be hair fine in width and in straight line grouted with neat colored cement slurry to match the colour of the marble. The joints shall be struck smooth but there shall be no meaning over the mortar of the slabs, the edges of the adjoining slabs shall
be in one plane. The flooring shall be kept undisturbed at least seven days and wet for 14 days. Marble flooring shall be given a final coat of wax polish of approved make.

**PVC FLOORING**

PVC flooring material is normally used for covering floor from decorative point of view in residential and non-residential buildings. This material gives a resilient and non-porous surface which can be easily cleaned with a wet cloth as dust and grime do not penetrate the surface. Since a burning cigarette will damage the neat surface of the PVC sheet, special care should be taken to prevent burning cigarette stumps to come in contact with the PVC flooring materials.

It shall be laid on a base that is finished even and smooth such as concrete, metal or timber boarding. Unevenness or undulations in the base will show badly on the surface and are liable to damage the PVC sheets/tiles.

**Materials**

The PVC flooring material shall conform to IS: 3462. It may be in the form of tiles, sheets or rolls as specified. It shall consist a thoroughly blended composition of thermoplastic binder, filler and pigments. The thermoplastic binder shall consist substantially of one or both of the following:

**Vinyl chloride polymer**

**Thickness**

The preferred thickness of PVC tiles for normal floor covering shall be 1.5, 2.0, 2.5, 3.0 or 4.0mm.

Thickness of PVC sheets shall be measured with micrometer of Ratechet type or a dial gauge graduated to 0.02mm. The micrometer shall have flat bearing surfaces of at least 6.5mm diameter at both contact points.

For sheets and rolls the thickness of the specimen shall be measured at twenty scattered points.

For polystyrene wall tiles, the cavity depth of the test specimen shall be measured at five points taken at random on the rear surface of each tile with a suitable depth gauge.

The width of flooring sheets and rolling in continuous length shall be 1000, 1500 and 2000mm. When supplied in rolls the length of the rolls shall not be less than 10 metre.

The measurement shall be carried out with a travelling microscope or suitable scale graduated to 0.02mm. Each tile shall be measured for length and width at the three quarter point in each direction.

**Tolerance**

<table>
<thead>
<tr>
<th>Thickness</th>
<th>Tolerance</th>
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<tbody>
<tr>
<td>Width</td>
<td>+ 0.15mm</td>
</tr>
<tr>
<td>(i) 300mm square tiles</td>
<td>+ 0.2mm</td>
</tr>
<tr>
<td>(ii)600mm square tiles</td>
<td>+ 0.4mm</td>
</tr>
<tr>
<td>(iii) 900mm square tiles</td>
<td>+ 0.6mm</td>
</tr>
<tr>
<td>Sheets and rolls</td>
<td>+ 0.1 per cent</td>
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</tbody>
</table>
Adhesive: - Rubber based adhesives are suitable for fixing PVC flooring over concrete, wooden and metal sub-floors. PVA based adhesives shall be used for concrete and wooden sub-floors. PVA based adhesives are not suitable for metallic surfaces and also for locations where there is constant spillage of water.

Preparation of Sub-Floors

Before laying PVC sheets/ tiles, it is essential to ensure that the base is thoroughly dry and damp proof as evaporation of moisture cannot take place once the PVC flooring is laid. Moisture slowly damages the adhesive resulting in PVC sheet/ tiles being separated from the base and curled up. In case of new work a period of 4 to 8 weeks shall be allowed for drying the sub-floor under normal conditions.

Concrete sub-floors on the ground floor shall be laid in two layers. The top of the lower layer of concrete shall be painted with two coats of A-90 gard (conforming to IS:1580) applied at the rate of 1.5 kg/ sqm. The top surface of the lower layer shall be finished smooth while laying the concrete so that the bitumen can be applied uniformly. The bitumen shall be applied after the concrete has set and is sufficiently hard. Bitumen felt conforming to IS:1322 shall be sand-witched in the sub-floor laid in two layers.

In new concrete floor, the smooth finish required shall be produced by using cement slurry spread on fresh concrete floor and finished smooth. If the concrete floor is old and surface not even, the surface should be made smooth by first cleaning it free of all foreign material and then a layer of cement mortar 1:2 (1 cement: 2 coarse sand) of average thickness of 6mm shall be applied on the surface finishing the surface smooth. The finished surface shall be cured for 7 days and then allowed to dry thoroughly.

Where it is expected that the dampness may find its way from the surrounding walls, the same shall also be effectively damp-proofed up to at least 150mm above the level of the sub-floor and the damp-proof treatment below the floor shall be extended over the walls.

Laying and Fixing

Prior to laying, the flooring tiles/ rolls/ sheets shall be brought to the temperature of the area in which it is to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours.

Where air-conditioning is installed, the flooring shall not be laid on the sub-floor until the conditioning units have been in operation for at least seven days. During this period the temperature shall neither fall below 200C nor exceed 300C. These conditions shall be maintained during laying and for 48 hours, thereafter.

Before commencing the laying operations, the sub-floor shall be examined for evenness and dryness. The sub-floor shall then be cleaned with a dry cloth. The PVC flooring shall not be laid on a sub-floor unless the sub-floor is perfectly dry.

The layout of the PVC flooring on the sub-floor to be covered should be marked with guidelines. The PVC flooring shall be first laid for trial, without using the adhesive, according to the required layout.

The adhesive shall be applied by using a notched trowel to the sub-floor and to the back side of the PVC sheet or tile flooring. When set sufficiently for laying, the adhesive shall be sticky to touch, but will not mark the fingers. In general, the adhesive will require about half an hour for setting. It should not be left after setting for too long a period as the adhesive properties will be lost owing to dust films and other causes.

Care should be taken while laying the flooring under high humidity conditions so that condensation does not take place of the adhesive. It is preferable to avoid laying under high humidity conditions.

The area of adhesive to be spread at one time on the sub-floor depends entirely upon local circumstances. In case of a small room, adhesive may be spread over the entire area but relatively small areas of tiles/ sheets flooring should be treated in a larger room.
When the adhesive is just tack free the PVC flooring sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface. After laying the sheet in position, it shall be pressed with suitable roller weighing about 5kg to develop proper contact with the sub-floor. The next sheet with its back side applied with the adhesive shall be laid edge to edge with the sheet already laid and fixed in exactly the same manner as the first sheet was fixed. The sheets shall be laid edge to edge so that there is minimum gap between joints.

The alignment should be checked after laying of each row of sheet is completed. If the alignment is not perfect, the sheets may be trimmed by using a straight edge.

The tiles shall be fixed in exactly the same manner as for the sheets. It is preferable to start laying of the tiles from the centre of the area. Care should be taken that the tiles are laid close to each other with minimum gap between joints. The tiles should always be lowered in position and pressed firmly on to the adhesive. Care should be taken not to slide them as this may result in adhesive being squeezed up between the joints. PVC tiles after laying shall be rolled with a light wooden roller weighing about 5kg to ensure full contact with the under layer. Any undulations noticed on the PVC surface shall be rectified by removing and relaying the tiles after thorough cleaning of the underside of the affected tiles. The adhesives applied earlier in such places shall be thoroughly removed by using proper solvents and the surface shall be cleaned to remove the traces of solvents used. Work should be constantly checked against guidelines in order to ensure that all the four edges of adjacent tiles meet accurately.

Any adhesive which may squeeze up between sheets or tiles should be wiped off immediately with a wet cloth before the adhesive hardens. If, by chance, adhesive dries up and hardens on the surface of the sheet or tile, it should be removed with a suitable solvent. A solution of one part of commercial butyleacetate and three parts of turpentine oil is a suitable solvent for the purpose.

A minimum period of 24 hours shall be given after laying the flooring for developing proper bond of the adhesive. During this period, the flooring shall not be put to service. It is preferable to lay the PVC flooring after completion of plastering, painting and other decorative finish works so as to avoid any accidental damage to the flooring.

When the flooring has been securely fixed, it shall be cleaned with a wet cloth soaked in warm soap solution (two spoons of soap in 5 litres of warm water).

Where the edges of the PVC sheets of tiles are exposed, for example in doorways and on stair treads, it is important to provide protection against damage of flooring materials. Metallic edge strips may be used and should be securely fastened to the sub-floor to protect edges of the flooring.

**Precaution for Maintenance**

PVC flooring subject to normal usage may be kept clean by mopping with soap solution using a clean damp cloth. Water shall not be poured on the PVC flooring for cleaning purpose as the water may tend to seep through the joins and cause the adhesive to fail. To maintain a good wearing surface a good appearance, the flooring may be periodically polished. When polish is applied frequently, a thick layer builds up which collects dirt and dust and is tacky to walk on.

If the traffic is light, the floor shall be given frequent brushing regular polishing by an application of new polish every 4 to 6 weeks. Under moderate traffic conditions the floor shall be given an occasional wash with a wet mop but no detergents shall be used so that the polish is not removed.

Application of polish may be done every one to three weeks. PVC flooring should not be over waxed. When this condition develops, the coatings should be cleared off with white spirit or paraffin and a light even coat of polish applied. When the PVC flooring has been polished, it will remain bright for a considerable period if dry
mop is applied each day. It is this daily ‘dry polish’ that maintains the glossy surface. After exceptionally heavy traffic PVC flooring should be swept with a hair groom, rubbed with a mop or cloth frequently rinsed in clean water and finally rubbed dry.

Mineral Fiber Ceiling

Mineral Fiber Suspended Ceiling System with (Regular) EDGE TILES WITH 24mm Exposed GRID. The tiles should have Humidity Resistance (RH) of 99%, Minimum NRC 0.5, Light Reflectance ≥83%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance UK Class 0 / Class 1 (BS 476 pt - 6 &7) in module size of 600 x 600 x 16mm with Bio Block coating on the face of the tile, suitable for Green Building application, with Recycled content of 38 - 41%. The tile shall be laid on with 24 mm wide T - section flanges having rotary stitching on all T sections i.e. the Main Runner, 1200 mm & 600 mm Cross Tees with a web height of 38mm and a load carrying capacity of 15.34Kgs/M2. The T Sections have a Galvanizing of 90 grams per M². The Tile & Grid system used together should carry a 15 year warranty. Installation to comprise main runner spaced at 1200mm centres securely fixed to the structural soffit using suspension system (specifications below) at 1200mm maximum centre. The First/Last suspension system at the end of each main runner should not be greater than 450mm from the adjacent wall. Flush fitting 1200mm long cross tees to be interlocked between main runners at 600mm centre to form 1200 x 600 mm module. Cut cross tees longer than 600mm require independent support. 600 x 600mm module to be formed by fitting 600mm long flush fitting cross tees centrally between the 1200 mm cross tees. Perimeter trim to be wall angles of size 3000x19x19mm, secured to walls at 450 mm maximum centres. The work of fixing rainwater pipes, grouting around mouth of rain water pipes and making khurra shall be done before starting the items of roofing. The roofing shall overlap the khurra surface by about 100mm. SUSPENSION SYSTEM accessories will be approved make consisting of M6 Anchor Fasteners or equivalent with Vertical Hangers made of Galvanized steel of size 26 x 26 x 25 x 1.2mm with a Galvanized Thickness of 80gsm, A pre Straightened Hanger wire of dia – 2.68 mm of 1.83 m length., thickness of 80gsm and a tensile strength of 344-413 MPa, along with Adjustable hook clips of 0.8mm thick, galvanised spring steel for 2.68 mm with a minimum pull strength of 110 kg. The adjustable clip also consists of a 3.5 mm aquiline wire to be used with the main runner. The work including, , cutting / making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc wherever, required.

GRANITE STONR FLOORING

General

Granite Stone shall be of the type specified and the material promptly in accordance with specifications, it shall be hard sound durable and tough free from cracks, and defects like cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

Materials

Granite Standard: Granite shall comply Standard Specification for material characteristics, physical requirements, and sampling for selection of granite.

All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Engineer – in -charge.

Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone in place.
CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGARH, ORISSA

Provide chases, reveals, ringlets, openings, and similar features as required to accommodate adjacent work.

**Shop Drawings:**

The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for approval. These drawings shall show all bedding, bonding, jointing and anchoring details, and the dimensions of each piece of granite. No final sizing or finishing shall be done until the shop drawings for that part of the work have been approved.

**STONE FIXING**

Proceed with the fixing of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

**Cleaning**

After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than detergents are used.

**Protection of Finished Work**

After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

**Defective Work**

Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained.

**Related sections**

All work related to this specification section should be coordinated with the works described in other specification sections, including:

- Mortar
- Joints
- Pointing
- Curing

**Mode of Measurement**

The finished work shall be measured correct to a centimeter in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of
materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.

**Rate**

The rate shall include the cost of materials and labor required for all the operations described above.

Granite stone flooring with 18mm thick stone flooring (sample of shall be approved by Engineer-in-charge) over 20 mm (average) thick base of cement mortar 1:4 (1 cement: 4 coarse sand) laid and jointed with grey cement slurry including rubbing and polishing complete with:

**GRANITE STONE SKIRTING/CLADDING**

**General**

Granite Stone shall be of the type specified and the material promptly in accordance with specifications, it shall be hard sound durable and tough free from cracks, and defects like cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

**Materials**

**Granite Standard:** Granite shall comply Standard Specification for material characteristics, physical requirements, and sampling for selection of granite.

All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Engineer – in -charge.

**STONE FIXING**

Proceed with the fixing of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

**Cleaning**

After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than detergents are used.

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After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

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Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained

Related sections

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Mortar
Joints
Pointing
Curing

**Mode of Measurement**

The finished work shall be measured correct to a centimeter in respect of length and breadth nearest to two places of decimal.

1. **Structural glazing**

   **General**
   
   1) Framing system
      Aluminium Powder coated extruded sections manufactured by reputed manufacturers. For all types of members like brackets, mullions, transom etc.
   
   2) Sealant
      As specified in the item of silicon sealant
   
   3) Insulation
      50mm thick glass wool of minimum density 48kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 Micro on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion.

   4) Heat reflective Toughened Glass
      Brown or Grey Colon or any shade approved by the Client/ Engineer-

**SCOPE OF WORK**

Preliminary Requirements

(i) The contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system for the proposed building, all in conformity with the drawings as shown.

(ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawings.

(iii) The curtain wall system shall also include the following activities:

(a) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings, metal closure, windows etc.

(b) All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.

(c) All thermal insulation associated with the system

(d) All fire protection associated with the system

(e) All copings and closure and metal cladding to complete the system

(f) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.
(g) Isolation of dissimilar metals and moving parts.
(h) Anticorrosive treatment on all metals used in the system.
(i) Polyester powder coating aluminium sections.
(iv) The contractor shall also be responsible for providing the following:
  (a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.
  (b) Mock-ups, samples and test units.
  (c) Performance testing of the curtain wall framing and glazing assembly.
  (d) Co-ordination with the work of other trade.
  (e) Insulation with glass wool 48 kg/ cum at spandrels area.
  (f) Protection.
  (g) All final exterior and interior cleaning and finishing of the curtain wall system.
  (h) As built record drawings and photographs.
  (i) Guarantees and warranties.
  (j) All hoisting, scaffolding, staging and temporary services.
  (k) Conceptualizing and design of a suitable maintenance system for curtain glazing.
  (v) The water tightness and structural stability of the whole curtain wall system are prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good at all the risk and cost of the contractor.
  (vi) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

Quality Consideration and Other Activities

(i) The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:
  (1) Metal quality, finishes and thickness
  (2) Glass quality, coating and thickness and proposed manufacturer’s brand names
  (3) Aluminium extruded sections including mullions and transoms together with structural calculations and proposed manufacturer’s brand name and also the name of agency proposed for fabrication work
  (4) Arrangement and jointing of components.
  (5) Field connections especially mullion to mullion and transom to mullion.
  (6) Fixing and anchorage system of typical wall unit together with structural calculations.
  (7) Drainage system and provision in respect of water leakage in the curtain wall system
  (8) Provisions for thermal movements.
  (9) Sealant and sealing methods.
  (10) Glazing method.
  (11) Wind load and seismic load and any other specific load considered in the design
(ii) Design concept over lightening protection link-up system of the curtain wall for connection and incorporation into the lightening conductor system of the building (Lightening conductor system of the building to be done by any other agency)
(iii) The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

Tolerances

Any parts of the curtain wall, when completed, shall be within the following tolerances:
(1) Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m length of any member or 6mm in any total run in any line.
(2) Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle must not exceed 9mm total at any location.
(3) Change in deviation must not exceed 3mm for any 3.5m run in any deviation.

**Test of Wind Pressure**

(i) The equivalent load of wind pressure or wind suction shall be given to the test unit as increasing or decreasing the inside pressure in the “pressure chamber” at which the test unit is fixed.
(ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.
(iii) The variation of dynamic pressure shall be of any approximate sine curve line.
(iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above.
(v) Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.
(vi) The deflection on the main structural parts in this condition shall not exceed:
    (1) 1/175 of the span between supports or 20mm, whichever is less for vertical elements.
    (2) 1/250 of the span between supports for horizontal elements.
    (3) The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.

**Test of Lateral Deflection per Floor Height**

(i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.
(ii) The deflection of every ± 2.5mm shall be increased up to ± 13mm on the test unit (static deflection test)
(iii) The dynamic deflection shall be applied up to ± 13mm.
(iv) The variation of dynamic deflection shall be of an approximate sine curve line, on period of 3 seconds.
(v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the same shall be observed.
(vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.

**Water Tightness Test**

(i) Water shall be sprinkled to the ‘Test Unit’ under wind pressure.
(ii) Pressure shall not be applied to the test unit
(iii) The volume of the sprinkling water in one minute shall be 5 litres per sqmpt minimum (01.gal/ sq.ft.)
(iv) All water leakage and drainage system at the joint and the openable sash of the curtain wall system shall be observed from the outside of the chamber.
(v) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.
(1) Install the test unit.
(2) Hold first water tightness test
(3) Hold test of wind pressure as described above
(4) Hold second water tightness test.
(5) Lateral deflection test
(vi) Water leakage shall not be observed inside at all parts of the test unit during first water tightness test.
8mm thick laminated wooden flooring

WOODEN LAMINATE FLOORING

Providing & fixing of EGGER laminate wooden flooring - Class 32(AC4) conforming to EN13329 standards (No Asian Manufacturing), thickness of plank minimum 8mm, size of plank - 1291mmx193mm, HDF core board to be swell stop plus with minimum density of 930 kg/m3 according to and conforming to EN622 type 5 standard. Product to be PEFC, FSC & Blue Angel certifications. Fixing to be done using 2mm PE foam and 0.2mm vapor barrier. Product to offer 20 years Guarantee for Residential/domestic use and 5 years Guarantee for commercial usage according to manufacturers guarantee document (Equivalent to Floor Master).

Laminated wooden flooring should be glue less Just Click patented locking system. Classification of use 32/23 with a surface abrasion resistance of class AC4/ IP > 4.00, slip resistance class R- 10 conforming to DIN EN 51130 standard, Impact Resistance IC 2, Formaldehyde Emission E1, Light fastness Level 6, Flame resistance - Cfl, Castor chair Type W, heat passing resistance 0.07 m2 K/W, static indentation EN 433 < 0.01, surface soundness EN 13329 > 1.4, e of plank size 1291x193x8 mm laminated flooring will be Laid over hard surface (Cement sand aggregate screed).
PLUMBING & FIRE-FIGHTING WORKS
SCOPE OF WORK

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 Plumbing/Fire fighting / Hot water Generator Drawings.

Without restricting to the generally of the foregoing shall include the following:-

- a) Supplying & Fixing of Sanitary Fixtures.
- c) Water supply including Hot & Cold (Internal & External).
- d) Pumps, water treatment & allied works.
- e) External Sewerage system.
- f) Storm Water Drainage System.
- g) Hot water generator & allied system

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 Engineer-in-Charge. If part of site is not available for any reason or there is some unavoidable delay in supply of materials stipulated by the Owner, the programme of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.

Works area shall be the area shown in the drawing.

SPECIFICATIONS

Work under this contract shall be carried out strictly in accordance with Specifications attached with the Tender & as per C.P.W.D. specifications 1996 Volumes I to VI.

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.

Works not covered as mentioned above shall be carried out as per relevant Indian Standards Specifications or Codes of Practice.

The work shall be carried out strictly as specified in Drawings & Technical Specifications. In case of any ambiguity, the details of particular item as given in specification shall supersede the details in Drawings.

EXECUTION OF WORK

The work shall be carried out in conformity with the individual services drawings and within the requirements of Architectural, Electrical, Structural and Other specialized services drawings.

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 programmed.
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 Engineer-in-Charge. 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.

**DRAWINGS**

All the 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.

Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

Contractor shall verify all dimensions at site and bring to the notice of the Architect or Engineer-in-Charge all discrepancies or deviations noticed. Architect's decision shall be final.

Large size details and manufacturers' dimensions for materials to be incorporated shall take precedence over small-scale drawings.

All drawings supplied with the Tender shall be returned in good conditions along with the Tender.

All drawings/sketches issued by the Architect or Consultant for the works are the property of the Architect or Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architect or Consultant.

**INSPECTION AND TESTING OF MATERIALS**

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.

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

All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-in-Charge.

All Testing Equipment shall be preferably located in special room meant for the purpose.

**METRIC CONVERSION**

All dimensions and sizes of materials and equipment given in the Tender document are commercial metric sizes.
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.

**REFERENCE POINTS**

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.

All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

**SHOP DRAWINGS**

The Contractor shall submit to the Engineer-in-Charge six copies of the shop drawings.

Shop drawings shall be submitted under following conditions:-

i. Contractor shall prepare shop drawings of plumbing / Fire fighting / Medical Gases / Boiler / Sewerage treatment plant etc, for the entire hospital within four weeks of the award of work. These drawings shall be submitted to the Engineer-in-Charge for approval and the work shall be executed at site on the basis of these approved drawings.

ii. Large scale drawings showing typical details for Toilets & Fixtures.

iii. Equipment layout, piping and wiring diagram.

iv. Structural supports/hanging/laying and jointing details for all types of pipes as required.

v. Layout plans as required and for any changes in the layout of Plumbing / Architectural Drawings.

**AS BUILT DRAWINGS**

The Contractor shall maintain one as built copy of all Drawings, Specifications, Addenda variations, approved submittals, correspondence, and transmittals at the site in good order and readily available to the Owner and the Engineer-in-Charge. The As built Drawings shall be clearly and correctly marked and as built specifications annotated by the Contractor to show all changes made during the construction process at the time the changed Work is installed. No such changes shall be made in the Work unless previously authorized by the change order or by specific approval of deviations or revisions in submittals.

The Contractor shall prepare and furnish to the Architect / services consultant accurate as built drawings. Architect / Services consultant shall approve these drawings after due verification at site. After approval, the contractor shall submit to Engineer-in-Charge, A1 size three (3) black line white paper prints as well as soft copy in form of CD of each drawing as part of close out documents. Project manager shall forward the same to the owner for their records and for maintenance and operation.

The as built drawings must have the following information:

The works as executed complete with:

- Run of all piping & diameters on all floors and vertical stacks.
- Ground and invert levels of all drainage pipes together with location of all manholes and connections up to out fall.
- Run of all water supply lines with diameters, locations, of Control Valves, Access Panels.
- Location of all Mechanical equipment with whole plant layout, piping connections and panels as erected.
- Details of supports left in place and locations of all services encountered.
- Complete schematic diagram of the installation, as installed.
- Complete Schematic flow diagram for Sewage treatment plant.
- Complete layout plan of Sewage treatment Plant.
- Hot water generator room layout and Schematic of the system

**CONTRACTORS RATES**

Rates quoted in this Tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

Rates quoted are for all heights and depths required for this work.

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 Engineer-in-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

**TESTING**

Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

Tests shall be performed in the presence of the Engineer-in-Charge / Consultant.

All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

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.

Contractor shall provide all labour, equipment and materials for the performance of the tests.

Contractor shall afford all the expenses for the offsite testing of material and equipments.

**SITE CLEARANCE AND CLEANUP**

The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

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.

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.

**LICENSE AND PERMITS**

Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.
Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, drainage and 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.

Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.

Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

CUTTING & MAKING GOOD

No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

GENERAL REQUIREMENTS

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 Drawing, Specifications and Drawings.

All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/Interior designer’s requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge.

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.

When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

Supporting and Fixing Devices

The contractor shall provide all supporting and fixing devices necessary to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly look in the final assembly. Where the location demands, the Architects may instruct the contractor to provide chromium plated or other similarly finished fixing devices. In such circumstances the contractor shall arrange to supply fixing devices and install them complete with appropriate vibration isolating pads, washers and gaskets.

Final Installation

The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply
and waste connections. The connection between building piping system and the sanitary fixtures shall be through proper unions and flanged 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 outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. 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 arranged as to give visible warning and discharge. A check shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

Joints/gaps between all sanitary appliances/fixtures and the floor/walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of color and shade to match that of the appliances/fixture and the floor/wall to the extent possible.

**Protection against Damage**

The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, crazing, staining breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the time of handing over, the contractor shall clean, disinfect and polish all fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped, stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

**EUROPEAN W.C.**

European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed cistern, as specified in Drawing. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

Each W.C. shall be provided with 110mm dia (OD) PVC connector connecting the ceramic outlet of W.C.

**INDIAN W.C.**

Indian W.C. pan shall be Orissa pattern of size as specified in the Drawing. Each W.C. shall be provided with a 100 mm dia cast iron or porcelain P or S trap with or without vent horn.

W.C. shall be flushed by means of an exposed or concealed type flush valve or as specified in Drawing.

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.

**URINALS**

Urinals shall be flat back large white glazed Vitreous China of approx. size 590x390x375mm.
Flat back 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 Engineer-in-Charge.

Flat back urinals shall be fixed with C.P. Brass screws and shall be provided with 32 mm dia Domical Waste leading to Urinal trap.

Urinals shall be flushed by means of sensor operated flush system.

Waste pipes for urinals shall be of the following:

**G.I. Pipes**

Waste pipes may be exposed on wall or concealed in chase as directed by the Engineer-in-Charge. Specifications for waste pipes shall be same as given in Sub Section.

**FLUSHING CISTERN**

Flushing cistern shall be concealed or Exposed type design for low volume dual flushes 3 Ltrs & 6 Ltrs as directed by Engineer-in-Charge or mentioned in the drawing.

**LAVATORY BASIN**

Lavatory Basins shall be white glazed vitreous china of size, shape and type as indicated in architectural drawings.

Each Basin shall be provided with MS. or C.I. brackets and clips and the basin securely fixed to wall. Placing of Basins over the brackets without proper securing and fixing shall not be accepted.

Each Basin shall be provided with 32mm dia C.P. waste with overflow, pop-up waste or rubber plug and chain, 32mm dia C.P. Brass Bottle Trap with C.P. pipe to wall and flange.

Each basin shall be provided with CP brass push type self closing pillar tap or Single hole Mixing Fitting as mentioned in the drawing.

Basins shall be fixed at proper heights as shown on architecture drawings. If height is not specified, the rim level shall be 79 cms above the floor or as directed by Engineer-in-Charge.

**SINKS**

Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the architectural drawing.

Hand Wash Sinks and Process Sinks shall be of stainless steel.

Each sink shall be provided with M.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 Engineer-in-Charge.

Fittings for sinks shall be mixing fittings or as specified in the architectural drawing.

**SHOWER SET**
Shower set shall comprise of single lever mixer adjustable hand shower.

Each shower set shall also be provided with Overhead C.P. shower with 100mm long arm with flange of approved quality.

Concealed stop cocks wherever required 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.

ACCESSORIES

Accessories shall be of any of the following types:

- **Towel rails**
  Towel rail shall be C.P brass of size 610mm long and 20mm dia, and fixing with C.P brass brackets fixed to wooden cleats with C.P. brass screws.

- **Towel rings**
  Towel rail shall be C.P brass of size 150mm dia, and fixing with C.P brass brackets fixed to wooden cleats with C.P. brass screws.

- **Toilet paper holder**
  Toilet paper holder shall be of Satin finish stainless steel AISI 316 grade wall mounted type fixed to wooden cleats with C.P. brass screws.

- **Hand Dryer**
  Hand dryer shall be of best quality, to be operated with 230 volts, single phase, with fully hygienic condition, with all accessories and fixing in the wall as mention in the Architectural drawing or as directed by Engineer-in-Charge.

- **Coat hooks**
  Coat hooks shall be of satin finish stainless steel AISI 316 grade wall mounted coat hooks fixed to wooden cleats with C.P. brass screws or as directed by Engineer-in-Charge.

- **Soap dispensers**
  Soap dispensers shall be of satin finish stainless steel AISI 316 grade wall mounted liquid soap dispenser with indicator having bottom trough of soap fixed to wooden cleats with C.P. brass screws or as directed by Engineer-in-Charge.

Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good.

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. The flange of the recessed fixture shall cover the recess in the wall fully.

Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge.

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 Engineer-in-Charge.

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.
URINAL PARTITIONS
Urinal partitions shall be white glazed vitreous china or 25mm/40 mm thick marble of size of 690x325mm.

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 Engineer-in-Charge.

TOILET FOR THE DISABLED
Where specified, in washroom facilities designed to accommodate physically disabled, accessories shall be provided as per the NBC Norms for Disable Persons architectural drawing or as directed by the Engineer-in-Charge.

Stainless steel grab bars of 600mm long suitable for expose mounting and penned non-slip gripping surface shall be provided in washroom for disabled persons. The flushing cistern shall be provided with chromium plated long handles.

TESTING AND ACCEPTANCE
Testing is done as per BS-5572 of Make & Model of Sanitary fixture & fittings

INTERNAL DRAINAGE SOIL, WASTE & VENT PIPES

SCOPE OF WORK
Work under this section shall consist of furnishing all labor, 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 as directed by the Engineer-in-Charge.

Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-

Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.

Connection of pipes to Gully Traps & Manholes etc.

Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads as specified.

Waste pipes connections from all Fixtures e.g. wash basins, sinks, urinals and kitchen equipments.

Testing of all pipes and connection joints.

GENERAL REQUIREMENTS
All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge.

Soil, waste and vent pipes in shafts, ducts and in concealed areas i.e. (false-ceiling) shall consist of uPVC, SWR Pipe.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

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.
Pipes shall be securely fixed to walls and shall be kept 50mm clear of wall.

Access doors for fittings and cleanouts shall be easily accessible for repair and maintenance.

Every waste pipe shall discharge above the grating of properly trapped gully. Contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided it shall be ensured that at least one washbasin/washing trough is connected to such floor traps to avoid drying of water seal in the trap.

All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75mm or more than 300mm from the highest part and on the side nearest to the soil pipe or waste pipe.

All works shall be executed as directed by Engineer-in-Charge.

**Soil, Waste & Vent Pipes**

a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains. Waste stacks have been provided with a "P" trap at basement.

b) All waste water from AHU's, A.C. plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.

c) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement or to an external manhole directly wherever feasible as shown on the drawings.

d) All soil and waste from areas below general ground level (Basements) will be collected in sumps and pumped into sewer lines.

e) Anti-siphonage pipe (ASP) shall be provided for soil fittings on vertical stacks. It may also be provided for waste lines where shown on the drawings.

f) Vent pipes shall be provided at all sewer lines at the starting manholes.

g) Waste pipe used in kitchen area shall be Cast Iron Pipes. All pipes shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects. Pipes shall be centrifugally cast (spun) iron pipes conforming to I.S.3989.

h) Jointing of pipe: All CI Pipe shall be joint with Drip seal PJS–43. It is a salient manufactured in two colours “Black” and “White”, and can be used for sealing of C.I Pipe joints. The density of Drip Seal PJS–43 should be 1.95 grams / c.c.

i) Mixing & Application: The Drip seal in two different colors is mixed homogeneously in the supplied packets. In cold conditions both unmixed packets are to be heated in Sun or heated to room temperature (25°C) to make them more workable for mixing. The pipe joint is cleaned to make it free from dust, grease, oil, cement splashes and all other foreign matters and contaminants. The joint is made dry. Hemp yarn is provided as usual in pipe joint as back filler. Force the mixed compound into the lap of pipe joint with Caulking tool, MS Flat piece or by Hand. Proper pressing of compound is necessary to avoid air entrapment. The joint is not to be disturbed till the compound is hardened. The mixed compound has a life of 30 to 40 minutes and should be used within this consumption period.

<table>
<thead>
<tr>
<th>Diameter of Pipe (mm)</th>
<th>Consumption per joint (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>130 to 150</td>
</tr>
<tr>
<td>80</td>
<td>150 to 170</td>
</tr>
<tr>
<td>100</td>
<td>200 to 250</td>
</tr>
<tr>
<td>150</td>
<td>250 to 300</td>
</tr>
</tbody>
</table>

**Rainwater Pipes**

a) All terraces shall be drained by providing down-takes rainwater pipes.

b) A separate piped drainage system for slopping roof with leaders shall be provided.
CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGARH, ORISSA

c) Rainwater pipes are separate and independent connected to the external storm water drainage system as shown on the drawings.

d) Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water drains.

e) Any dry weather flow from waste appliances, AHU’s pump rooms, shall be connected to the sewerage system only.

Balcony/Planter drainage

Open balconies, terraces, planters and formal landscape areas will be drained by a separate pipe connected to external storm water drainage system.

uPVC pipes for SWR system (for soil waste and rain water)

Pipes
- All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be conforming to I.S. 13952 type B for soil & waste and of type A for rain water.
- Pipes shall be joined by approved type of socket and ‘O’ rubber ring (confirms to I.S. 5382) joints with rubber lubricant.

Fittings
- Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching I.S. Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.
- Fittings shall be of the required degree of curvature with or without access door.
- Connection from a vertical stack or position to a horizontal line shall be made only by a “Y” junction.

Fixing
- All vertical pipes shall be fixed truly vertical to walls with approved type of uPVC saddle clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-
- Horizontal pipes running along shall be fixed on galvanized structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
- Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Engineer-in-charge for making such provisions in the Structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

Clamps
- Holder bat clamps shall be of standard design and fabricated from galvanized M.S. standard flats 40x3 mm thick and 12 mm dia M.S. Rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1:2:4 mix blocks 10x10x10 cms deep.
- Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with galvanized 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
- For SWR pipes conforming to IS 13592 shall be clamped to wall with approved type of uPVC saddle clamp/ U-clamp or as given in the Bill of quantities.
- Structural clamps shall be fabricated by electro-welding from M.S. structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- Galvanized 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 schedule of quantities. 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.
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 20 mm nominal size) as directed by the Engineer-in-Charge.

For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

### CLAMP AND PIPE SUPPORT SPACING

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of Pipes &amp; Position</th>
<th>15/20</th>
<th>20/25</th>
<th>32/40</th>
<th>50</th>
<th>75/80</th>
<th>100/110</th>
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<tbody>
<tr>
<td>1</td>
<td>Vertical Pipes</td>
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</tr>
<tr>
<td>1.1</td>
<td>GI / MS Pipes</td>
<td>2.4</td>
<td>2.4</td>
<td>3</td>
<td></td>
<td>3.6</td>
<td>4.5</td>
<td>5.4</td>
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<tr>
<td>1.2</td>
<td>uPVC Pipes</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1 m</td>
<td></td>
<td></td>
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<tr>
<td>1.3</td>
<td>uPVC / cPVC Pipes</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>1 m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Horizontal Pipes</td>
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<td></td>
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</tr>
<tr>
<td>2.1</td>
<td>GI / MS Pipes</td>
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<tr>
<td>2.2</td>
<td>uPVC Pipes</td>
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</tbody>
</table>

Traps

Floor traps

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and main waste pipes in toilets having 150 mm sinking shall run below slab and shall be supported from the below. The trap and waste pipes in sunken area (where required) 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 cms of the required depth.

Urinal traps

Urinal traps/horn shall be cast iron P or S traps with or without vent shall be fixed as specified for floor traps.

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 fitting fabricated from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to a...
uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. uPVC multi-inlet trap can be used wherever possible to be decided by the Engineer-in-Charge.

**Trap & Seals**

All traps shall be self cleaning design and the seal depth shall be as specified below wherever the traps are not integral with the appliances:

<table>
<thead>
<tr>
<th>Appliance or ware</th>
<th>Material</th>
<th>Trap Type</th>
<th>Seal depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatory /wash basin</td>
<td>C.P. cast brass</td>
<td>32 mm dia Bottle</td>
<td>75 mm</td>
</tr>
<tr>
<td>Sink</td>
<td>C.P. cast brass</td>
<td>40 mm dia Bottle</td>
<td>75 mm</td>
</tr>
<tr>
<td>Kitchen floor drain of fabricated drain boxes</td>
<td>uPVC/C.I.</td>
<td>75/100 mm dia ‘P’ or ‘S’</td>
<td>50 mm</td>
</tr>
<tr>
<td>Urinals</td>
<td>uPVC/C.I.</td>
<td>100 mm dia ‘P’ or ‘S’</td>
<td>50 mm</td>
</tr>
<tr>
<td>AHU’s</td>
<td>uPVC/C.I.</td>
<td>75 mm dia ‘P’ or ‘S’</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

**Floor Gratings**

Floor and urinal traps shall be provided with 100-150mm square or round C.P./ Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm.

**Jointing**

Pipe to pipe and pipe to fitting (SWR) joint shall be with ‘O’ rubber ring as recommended by the manufacturer. Jointing with solvent cement shall be applied to uPVC waste pipes (confirming to I.S. 4985) and fittings or as recommended by the manufacturer’s.

**Cleanout Plugs (on soil pipes)**

32.6.1 uPVC Clean out pipe for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, “Y’s” and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.

32.6.2 Cleanout on Drainage Pipes

Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Engineer-in-Charge Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 160 mm OD.

Cleanouts at level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

**Waste pipe from appliances**

- **General**
  - a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of uPVC pipes 40, 50 or 63 mm OD conforming to IS:4985 class II (6 kg/cm²) shown on the drawings.
b) 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 level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section

**Encasing Pipe in Cement Concrete**

uPVC soil and waste pipes and drainage under floor 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 all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one meter.

**Testing**

Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement.

Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.

All materials obtained and used on site must have manufacturer's Hydraulic Test Certificate for each batch of materials used on the site.

**Testing Soil, Waste and Rainwater Pipes**

Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. Rectify and replace where required.

Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Engineer-in-Charge and signed by both.
EXCAVATION FOR PIPE LINE

EXCAVATION

The excavation for pipe works shall be open cutting unless the permission of the Engineer-in-Charge for the ground to be tunnelled is obtained in writing. Where sewers have to be constructed along narrow passages, the Engineer-in-Charge may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be brought back later on for refilling the trenches or tunnel.

Opening out Trenches

In excavation the trenches, etc. the solid road metal ling, pavement, curbing etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Engineer-in-Charge and of the Owners of the roads or other property traversed and the Contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall tunnel under them, unless the Engineer-in-Charge shall order to the contrary.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Engineer-in-Charge.

Obstruction of Roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Engineer-in-Charge in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

Removal of Filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

Excavation to be taken to Proper Depths

The trenches shall be excavated to such a depth that the pipes shall rest on concrete or on firm bedding as described in the several clauses relating to these so that the inverts may be at the levels given in the sections. In bad ground, the Engineer-in-Charge may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewers with concrete, broken stone, gravel or other materials. For such extra excavation and concrete, broken stone, gravel or other materials, the Contractor shall be paid extra at rates laid down for such works in the schedule, if the extra work was ordered by the Engineer-in-Charge in writing, but if the Contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Engineer-in-Charge the extra depth shall have to be filled up with concrete 1:5:10 mix (1 cement: 5 fine sand: 10 stone aggregate 40mm nominal size) at the Contractor’s own costs and charges to the requirements and satisfactions of the Engineer-in-Charge.

Refilling

After the pipes or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15
**Contractor to Restore Settlement and Damages**

The Contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expenses and charges, repair and make good and damage done to buildings and other property. If in the opinion of the Engineer-in-Charge he fails to make good such works with all practicable dispatch, the Engineer-in-Charge shall be at liberty to get the work done by the Contractor or deducted from any money that may be or become due to him or recovered from him in any other manner according to the law of the land.

**Disposal of Surplus Soil**

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

**Timbering of Sewer and Trenches**

The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be close, timbered in loose or sandy strata and below the surface of the sub soil water level.

All timbering, sheeting and piling with their waling and supports shall be of adequate dimensions and strength and fully braced and strutto so that no risk of collapse or subsidence of the walls of the trench shall take place.

The Contractor shall be held responsible and will be accountable for the sufficiency of all timbering, branches, sheeting and piling used as also for all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

**Shoring of Buildings**

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

**Removal of Water from Sewer, Trench etc.**

The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

**Width and Depth of Trench**

...
The Engineer-in-Charge shall have power by giving an order in writing to the Contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classes of sewer, manholes, and other works in certain lengths to be specifically laid down by him, where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.

SECTION – IV WATER SUPPLY SYSTEM (COLD & HOT)

SCOPE OF WORK

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.

Without restricting to the generality of the foregoing, the water supply system shall include the following:-

a) Municipal water connection including water meter up to U.G. water tanks.

b) Piping from tube well to raw water tank.

c) Distribution mains from hydro pneumatic system to all fixtures and appliances for cold water to buildings.

d) Distribution system from overhead tank to single toilet in the building.

e) Distribution mains from hydro pneumatic system to all fixtures and appliances for flushing water to buildings.

f) Excavation and refilling of pipes trenches.

g) Control valves, masonry chambers and other appurtenances.

- All water lines to different parts of building and making connection from source etc.
- Pipe protection and painting.
- Providing Hot water supply and return lines and insulation of hot water pipe lines.
- Control valves, masonry chambers and other appurtenances.
- Connections to all toilets kitchen equipments, tanks and appliances.
- Excavation and refilling of pipe trenches, wherever necessary.
- Trenches for taking pipe lines for these services if required.

GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

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.

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.
Pipes shall be securely fixed to walls and s by suitable clamps at intervals specified.

As far as possible, all piping inside the buildings shall run either concealed or embedded. Outside the buildings the piping shall be installed at least 60cms below finished grade. All galvanized steel piping embedded either in trenches or in concrete and masonry work shall be tightly wrapped 1mm thick fiberglass tissue laid in bitumen.

Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

Water Supply System

Contractor should study the site plan and water supply system diagram for an overview of the system.

Source

a) Water supply will be acquired from Municipal water mains through a service connection

b) Additional water supply will be obtained from captive tube wells within the site. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank.

Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independently connected to a different pumping system.

G.I. PIPES & FITTINGS

All pipes outside the building and pipes running at basement level shall be galvanized steel tubes conforming to IS: 1239-1979 of class specified. When class is not specified they shall be medium class.

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 and Bushes. Fittings shall be of IS:1879 - (part I to X) 1975.

Pipes and fittings shall be jointed with threaded fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. 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 or floors and other as shown on drawings.

CLAMPS

G.I. pipes in shafts and other locations shall be supported by galvanized clamps of design approved by Engineer-in-Charge. Pipe in wall chases shall be anchored by iron hooks. Pipes at level shall be supported on structural clamps fabricated from galvanized structural as described in the sub section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

Pipe hangers shall be provided at the following maximum spacing:
### S. No. | Pipe Dia (mm) | Hanger Rod Dia (mm) | Spacing between Supports (Mtr)
--- | --- | --- | ---
1 | Upto 25 | 6 | 2
2 | 32 to 50 | 10 | 2
3 | 65 to 100 | 12 | 2.4
4 | 125 to 150 | 16 | 3.6
5 | 200 to 300 | 19 | 5.3

**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 Engineer-in-Charge.

**FLANGES**
Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge. 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 Engineer-in-Charge. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

**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:

<table>
<thead>
<tr>
<th>Dia of Pipe</th>
<th>Width of Trench</th>
<th>Depth of Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>15mm to 50mm</td>
<td>30 cms</td>
<td>60 cms</td>
</tr>
<tr>
<td>65mm to 100mm</td>
<td>45 cms</td>
<td>75 cms</td>
</tr>
</tbody>
</table>

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 earth work 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.

**PAINTING**
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 color code specified by Engineer-in-Charge.

All pipes in chases and below floor shall be provided with Anti-corrosive treatment.

PIPE PROTECTION

Where specified in the Drawing all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of PYPKOTE/MAKPOLYKOTE over the pipe.

Sand Filling

All G. I. pipes in trenches shall be protected with fine sand 150 mm all around before filling in the trenches.

GUNMETAL VALVES

Valves 65mm dia and below shall be heavy Gunmetal Full way Valves or Globe Valves or Ball valves conforming to IS: 778-1971 of 20 Kg/cm2 class. Valves shall be tested at manufacturer’s works and the same stamped on it.

All Valves shall be approved by the Engineer-in-Charge before they are allowed to be used on work.

SLUICE VALVES

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.

Sluice valves shall be of best quality conforming to IS: 780-1969 of class specified.

- Joints for double flanged sluice valves shall be made with suitable 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.

- Sluice valves shall be installed at all branches and as shown on the drawings.

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 Engineer-in-Charge.

Air Release Valves
• Air release valves shall be single acting type air valves with Gunmetal body and bronze/gunmetal internal parts and plastic float.
• Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

INSULATION

For Chased Internal Pipes

Hot water pipes fixed in chase shall be thermal insulation over hot water pipes with 9mm thick nitrile or approved equivalent thermal insulation tubing, a elastomeric flexible material having hermetic blister closed cell structure of expanded synthetic rubber having a thermal conductivity not exceeding 0.040w/m°k @ 40deg C over pipes.

For Exposed Piping

Exposed hot water line laid in trenches, exposed in shafts, on terrace and along level shall be thermal insulation over hot water pipes with 9mm thick nitrile/ polyolefin or approved equivalent thermal insulation tubing, a electrometric flexible material having hermetic blister closed cell structure of expanded synthetic rubber having a thermal conductivity not exceeding 0.040w/m°k @ 40 deg C over pipes. With Aluminum Cladding/ protective coating of resin hardener paint with fiber cloth (FRP)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Pipe Size (MM)</th>
<th>Thickness of Nitrile Rubber Insulation (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 to 25</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>32 to 80</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>100 &amp; above</td>
<td>19</td>
</tr>
</tbody>
</table>

Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

CPVC PIPES

All pipes inside the buildings and where specified, outside the building shall be CPVC pipes tubes conforming to IS 15778:1996 .Specific Gravity ASTM D 792 at 23°C should be 1.55 as specified. With Tensile Strength as per ASTM D 638 at 23°C should be 55N/mm².

Joining Pipe & Fittings

Cutting
Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

**Deburing / Beveling**

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fitting during assembly.

**Fitting Preparation**

A clean dry rag/cloth should be used to wipe dirt and moisture on the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

**Solvent Cement Application**

Only CPVC solvent cement confirming to ASTM-F493 should be used for joining pipe with fittings. CPVC schedule 40 & 80 heavy bodied CPVC solvent cement only should be used confirming to ASTM-F493.

**Assembly**

After applying the solvent cement on both pipe and fitting socket, pipes should be inserting into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approx) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous, remake the joint to avoid potential leaks.

**Set & Cure times:**
Solvent cement set & cure times shall be strictly adhered to as per the below mentioned table:

Minimum Core prior to pressure testing at 150 PSI

<table>
<thead>
<tr>
<th>. No.</th>
<th>Ambient Temperature during Core period</th>
<th>Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>½” to 1”</td>
</tr>
<tr>
<td>1</td>
<td>Above 15 deg C</td>
<td>1 Hr</td>
</tr>
<tr>
<td>2</td>
<td>4 – 15 deg C</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>3</td>
<td>Below 4 deg C</td>
<td>4 Hrs</td>
</tr>
</tbody>
</table>

Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 PSI (10 Bar) for minimum 24hrs. During pressure testing the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using coupler.

**Transition of CPVC to Metals**

When making a transition connection to metal threads, special brass/plastic transition fitting (Male & Female adopters) should be used. Plastic threaded connection should not be over torque hard tight plugs one half turn should be adequate.

**Threaded Sealants**
Teflon tapes shall be used to make threaded connection leak proof.

**Hangers & Supports**

For horizontal runs, support should be given at 3 ft (90 cms) intervals for diameter of 1” and below and at 4 ft (1.20 mtr) intervals for larger size.

Hangers should not have throw or sharp edges which come in contact with the tubing and shall be of GI.

Support should be as per the below mentioned table:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Size of Pipe Inch</th>
<th>210C Ft</th>
<th>490C Ft</th>
<th>710C Ft</th>
<th>820 C Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>½”</td>
<td>5.5</td>
<td>4.5</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>¾”</td>
<td>5.5</td>
<td>5.0</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>1”</td>
<td>6.0</td>
<td>5.5</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>11/4”</td>
<td>6.5</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>5</td>
<td>11/2”</td>
<td>7.0</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>6</td>
<td>2”</td>
<td>7.0</td>
<td>6.5</td>
<td>4.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>

All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves, etc shall be made of CPVC by licensee.

The CPVC solvent cement used for installing CPVC piping systems shall conform to ASTM F493. Pipes from ½” up to 2” pipes and fittings, single step medium bodied CPVC solvent cement should be used. For CPVC pipes and fittings upwards of 2”, a primer shall be used followed by heavy bodied solvent cement conforming to ASTM F493. *PVC solvent cement should not be used.*

**Concealed Plumbing**

All internal concealed plumbing for water supply shall be done with CPVC pipes. The pipes & fittings shall conform to CTS (Copper Tube Size) SDR-11 as per ASTM D2846. All pipes and fittings from ½” up to 2” shall come under this category. Medium body CPVC solvent cement conforming to ASTM F493 should be used for joining pipes to fittings.

**Installation procedure**

All parameters pertaining to the installation of CPVC plumbing system such as cutting, joining, support spacing, expansion loops, insulation, type of support, special connections, etc. shall be as per the manufacturer’s specifications.

**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 with cast iron surface box as approved or as specified in Drawing and in drawings including excavation, back filling complete.

**WATER METERS**

Water meters of approved make and design shall be supplied for installation at locations as shown in drawing. The water meters shall meet with the approval of the local municipal authorities. Suitable valves and chambers to house the meters shall also be provided along with the meters.

All meters shall conform to Indian Standard IS: 779-1978 (Water meters-domestic type) and IS: 2373-1981 (water meters-bulk type). Where called for water meters shall be located in masonry chambers of appropriated size.

**PIPE HANGERS BRACKETS ETC.**

Sturdy hangers, brackets and saddles of approved design shall be installed to support all pipe lengths which are not embedded over their entire run. The hangers and brackets shall be of adjustable heights and primer coated with red-oxide primer clamps. Collars and saddles to hold pipes shall be provided with suitable gaskets. The brackets and hangers shall be of Mild Steel designed to carry the weight of pipes safely and without excessive deflections.

All pipes and fittings shall be supported near every joint and half-way through every pipe length unless otherwise specified. Where called for, pipe hangers shall also be supplied with proper sound and vibration dampening devices to minimize noise and vibration transmission.

**TESTING**

All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm² in any case and with the consent of Engineer-in-Charge.

Pressure shall be maintained for a period of at least TWELVE hours without appreciable drop in the pressure after fixing at site. (+10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

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.

After completion of the water supply system, Plumbing 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.

**CONNECTIONS TO WATER TANKS**

The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflow, control valves and all such other piping connections including level indicator to water storage tanks as called for.
Suitable float controls of an approved make, securely fixed to the tank independent of the inlet pipe and set in a position so that water inlet into the tank is cut off when filled up to the water line. The water level in the tanks shall be adjusted to 25mm below the lip of the overflow pipe. Full way gate/ball valves of approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe.

The overflow pipe shall be so placed as to allow the discharge of water being readily seen. The overflow pipe shall be of size indicated. A stop valve shall also be provided on the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning. The ball valves shall conform to Indian Standard IS:1703-1968

CONNECTIONS TO MECHANICAL EQUIPMENT SUPPLIED BY OTHER AGENCIES

All inlets, outlets, valves, piping and other incidental work connected with installation of all mechanical equipment supplied by other agencies shall be carried out by the Plumbing contractor in accordance with the drawings, requirements for proper performance of equipment, manufacturer’s instructions and the directions of the Engineer-in-Charge. The equipment to be supplied by other agencies consists mainly of Kitchen, Laundry, Air-conditioning, Water Treatment and other similar equipment. The connections to the various equipment shall be effected through proper unions and isolating valves. The work of effecting connections shall be executed in consultation with and according to the requirements of equipment suppliers, under the directions of the Engineer-in-Charge. The various aspects of connection work shall be executed in a manner similar to the work of respective trades mentioned elsewhere in these specifications.

DISINFECTION

After completion of the work Contractor shall flush clean the entire system with the city’s filtered water after connection has been made.

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. The Commissioning would not be considered complete without performing the Disinfection.

PRE COMMISSIONING:

Ensure that all pipes are free from debris and obstructions.

Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.

Ensure that all Connections to Branches has been made.

Ensure that mains have been connected to the respective pumps, underground and Overhead tanks.

Water supply should be available at main Underground tank.

All main line Valves should be closed.
COMMISSIONING

Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

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.

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).

Fill Overhead tank to full.

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.

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.

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.

The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

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).

RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.

SECTION –V: TUBEWELL

GENERAL CONDITIONS AND SPECIFICATIONS FOR TUBEWELL

General Conditions

All work shall be done in a systematic manner in accordance with a programmer prepared in consultation with the Engineer-in-Charge. Rates quoted shall be for complete items and inclusive of all equipment, labor, scaffolding, tackles etc required to do a complete job.

Rates shall be inclusive of all taxes, e.g. Sales Tax, Octroi, Excise Duty etc.

Expected quantity of water required is in the order of 10,000 LPH on 10-12 hours continuous pumping, but lower flow will be acceptable if the strata yield is such.

No payment shall be made for the abandoned bores.
Water Supply & Power

Contractor shall make his own arrangement for water at site required for his work. He may obtain the water by boring a trial bore or by obtaining in water tankers at his own cost.

Contractor shall also make his own arrangements for power required for his work.

Site Clearance

The Contractor shall clear the site for any trees, growth, grass and rubbish to enable him to execute the work properly at his own cost.

On successful completion of the work the Contractor shall clear up the site of all his surplus material equipment and accessories and hand over the same to the Engineer-in-Charge.

Specifications

Type of Well

a) Tube well shall be bored by a reverse circulation rotary rig with 600 mm dia (24") blind and slotted pipe. Annular space between pipe and bore shall be gravel packed.

Boring

Boring shall be 600-650 mm dia to an approximate depth of 80-90 m. The depth may be increased or decreased as per actual site conditions. The depth at which the tube well boring is to be terminated shall be as agreed upon by the Engineer-in-Charge Sub-soil water shall not be tapped.

Well and Housing Pipes

Pipes shall be uPVC pressure pipe with couplings.

Slotted Pipes

Slotted pipes shall be 250 mm dia, with slots. Slot size shall be as per soil conditions and shall be approved by the Engineer-in-Charge. No variation in rate shall be permissible due to size and dimension of slots.

Special Fittings

Provide all special fittings e.g. blank pipes, socket rings, bail plug, centering guides, pipe slips and top cap suitable for housing pipe.

Verticality

Well assembly shall be truly vertical as per latest Indian Standard and verticality certificate shall be furnished by the Contractor.

Gravel Packing
Space between boring and well assembly shall be packed with washed pea gravel 3 to 6 mm size.

Development

The well shall be developed by an air compressor of 450 cfm capacity and pressure of 10.5 kg/cm² for a period of at least twenty hours. This period may however be extended in case the development is not satisfactory.

Water Tests

The Contractor shall get the water tested for its quality from approved Water Testing laboratory given Annexure I. Tests shall be for drinking water quality as per IS: 10500 for Physical, Chemical & bacteriological parameters. (Tests shall be performed after development of the well and clear water is available in the discharge).

Sanitary Sealing

The annular space between the bore and its housing pipe shall be grouted with cement concrete 1:2:4 to a depth of 5 m below the ground level. Four 50 mm dia gravel feeding shall be provided with caps at top. Pipes shall be G.I. to I.S. 1239, medium class.

Bore Log

A bore log in a standard format form shall be maintained at the site and shall give the following information.

a) Description and depth of strata

b) Spring level below ground.

c) Aquifer opposite which slotted pipes have been placed.

d) Rate of progress of drilling

e) Full particulars of final test

f) Four copies of strata sheets yield and water quality tests shall be handed over on completion of the well.

g) Suggested depth for the tube well submersible pump.

SECTION –VI: GARDEN HYDRANT SYSTEM

SCOPE OF WORK

The scope of this section comprise of the supply, installation testing and commissioning of piping network for garden hydrant & irrigation system.
Work under this section consists of furnishing all labor, materials equipment and appliances necessary and required to completely install the garden irrigation system as required by the drawings, specified hereinafter and given in the Drawing.

Without restricting to the generality of the foregoing, the garden hydrant system shall include the following:-

- All irrigation lines to different parts of site and making connection from source i.e. from STP etc.
- Pipe protection.
- Control valves, masonry chambers and other appurtenances.
- Connections to all hydrant point.
- Excavation and refilling of pipe trenches, wherever necessary.
- Trenches for taking pipe lines for these services if required.

GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

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.

As far as possible shall be installed at-least 60cms below finished grade.

Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

FLANGES

Flanged connections shall be provided on pipes where ever required or as directed by Engineer-in-Charge. Connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion rubber washer.

TRENCHES

The HDPE 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:

<table>
<thead>
<tr>
<th>Dia of Pipe</th>
<th>Width of Trench</th>
<th>Depth of Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>15mm to 50mm</td>
<td>30 cms</td>
<td>60 cms</td>
</tr>
<tr>
<td>65mm to 100mm</td>
<td>45 cms</td>
<td>75 cms</td>
</tr>
</tbody>
</table>
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 earth work 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.

PIPE PROTECTION

Where specified in the Drawing all pipes below ground shall be in trenches and protected with fine sand 150 mm all around before filling in the trenches.

SECTION – VII: SEWERAGE/DRAINAGE SYSTEM

SCOPE OF WORK

Work under this section shall consist of furnishing all Labor, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as specified hereinafter or given in the Drawing.

Without restricting to the generality of the foregoing, the sewerage system shall include:

- Internal/External sewer line.
- Excavations including refilling etc.
- Construction of Collection Chambers, Manholes and Drop Connections.
- Construction of Grease Trap etc.
- Connection to S.T.P and Disposal of treated effluent.
- Storm Water Drainage and Disposal.
- Construction of Desalting chamber & Rain water Harvesting tank
- Testing of pipe lines

GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge.

Drainage lines shall be laid to the required gradients and profiles.

All piping shall be installed at depth greater than 80cms below finished ground level.

The piping system shall be vented suitably at the starting point of all branch drains, main drains, and the highest/lowest point of drain and at intervals as shown. All venting arrangement shall be un-obstructive and concealed.

All drainage work shall be done in accordance with the local Municipal bye-laws.
Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Engineer-in-Charge.

Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge before the actual execution of work at site.

All works shall be executed as directed by Engineer-in-Charge.

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 Engineer-in-Charge 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 Engineer-in-Charge.

SALT GLAZED STONEWARE PIPES

Stoneware pipes shall be of first class quality salt glazed and free from rough texture inside or outside and straight. All pipes shall have the manufacturers name marked on it and shall comply to IS: 651-1971 and shall be of approved makes.

The maximum permissible slope to the various diameters of pipes shall be as follows:

- 100mm pipe: 1 in 40 to 1:50
- 150mm pipe: 1 in 60 to 1:100
- 200mm pipe: 1 in 80 1: 120 to 1: 200
- 250mm pipe: 1 in 90 1: 120 to 1: 250

Where necessary, pipe shall be laid on a bed of plain cement concrete 1:3:6 and minimum 150 mm thick, and shall be projected by providing hunching up to half the diameter of the pipes. The width of the concrete bed for various diameters shall be as follows:

- 100mm dia pipe: 380mm wide
- 150mm dia pipe: 450mm wide
- 200mm dia pipe: 600mm wide
- 250mm dia pipe: 700mm wide

Where the pipes are laid on a soft soil, with the maximum water table level, lying at the invert level of the pipe, the pipe shall be bedded in concrete.

Laying and Jointing of Stoneware Salt Glazed Pipes
Laying of Pipes

Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.

The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor’s cost and charges.

If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

Jointing of Pipes

Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.

After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or “Badger”. The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Engineer-in-Charge. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

- Gully Traps
  Gully traps shall be of the same quality as described for stoneware pipes in Clause 5.

  Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) and a brick masonry chamber 30x30 cms inside in cement mortar 1:3 with 10 x 10 cms grating inside and 30x30 cms C.I. sealed cover and frame weighting not less than 7.2 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

- Grease Trap
Grease Trap shall be provided on Kitchen waste lines before discharging the waste into the main sewer line. Grease Trap shall be built in brick masonry and shall be similar in construction to manholes. The grease trap shall be constructed to size as shown at the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanized wrought iron sediment pan and a baffle wall. Grease trap shall be provided with 2 Nos, double seal manhole cover and frame which shall be identified with lettering "Greas" as per the drawing.

- Testing of Grease Trap

All rights of the sewer and drain shall be carefully tested for water tightness by mains of water pressure maintained for not less than 30 minutes. Testing shall be carried out for manhole to manhole. All pipes shall be subject to a test pressure of 1.5 meter head of Water. The test pressure will however, not exceed 6mtr head at any point. The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.

REINFORCED CEMENT CONCRETE PIPES

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.

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 Engineer-in-Charge

Encasing (all pipes have to be encased)

The sewer pipes shall be completely encased or surrounded with concrete where:

- The maximum water table level is likely to rise above the top of the barrel.
- The top (overt) of pipe is less than 200 cms under the road surface.

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 semi flexible type collar joint.
Curing

The joint shall be cured for at least 7 days. Refilling at joints will be permitted only on satisfactory completion of curing period.

CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC.

Materials

Water

Water used for all the construction purposes shall be clear and free from Oil, Acid, Alkali, Organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered well enough for construction purpose.

Aggregate for Concrete

The aggregate for concrete shall be in accordance with I S: 383 and I S: 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Engineer-in-Charge. The size of the coarse aggregate shall be done as per I S: 383.

Sand

Sand for various constructional purposes shall comply in all respects with I S: 650 and I S: 2116. It shall be clean, coarse hard and strong, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Engineer-in-Charge as harmful for the construction.

Cement

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I S: 269.

Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I S: 432 (Grade I).

Bricks

Bricks shall have uniform color, thoroughly burnt but not over burnt, shall have plan rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Engineer-in-Charge.

Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the I S code. All such materials shall be approved by the Engineer-in-Charge before use.

Cement Concrete (Plain or Reinforced)
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 Engineer-in-Charge. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bass at all times. All pipe trenches and foundations shall be kept dry during the curing period.

**Masonry Work**

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Drawing in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

**Cement Concrete for Pipe Support**

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 Drawing. Type of the bedding is as described as follows:

Unless otherwise directed by the Engineer-in-Charge cement concrete for bed, all round or in haunches shall be laid as follows:-

<table>
<thead>
<tr>
<th>Description</th>
<th>Up to 3 M depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes in open ground (No sub soil water)</td>
<td>All round (1:4:8)</td>
</tr>
<tr>
<td>Pipes (all) in sub soil water condition</td>
<td>All round (1:4:8)</td>
</tr>
<tr>
<td>Pipes under the building or at road crossing or under public places</td>
<td>All round (1:3:6)</td>
</tr>
</tbody>
</table>

(1=1 cement, 3=5=coarse sand, 6-10 stone aggregate 40mm nominal size)

R.C.C. pipes or C.I. pipes may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.

Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

**MANHOLES AND CHAMBERS**

All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:5 (1 cement: 5 coarse sand) or as specified in the Drawing.

All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix or shown on the drawings.

Where not specified, Manholes will be constructed as follows:-
(All dimensions internal clear in cms)

<table>
<thead>
<tr>
<th>Size of Manhole Type</th>
<th>90x80 Rect.</th>
<th>120x90 Rect.</th>
<th>910 dia Circular</th>
<th>1220 dia Circular</th>
<th>1520 dia Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum depth</td>
<td>100</td>
<td>245</td>
<td>170</td>
<td>230</td>
<td>Any depth beyond 230</td>
</tr>
<tr>
<td>Average thickness of R.C.C slab</td>
<td>15</td>
<td>15</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Size of cover and frame (Internal dia)</td>
<td>61x45.5</td>
<td>50 dia</td>
<td>56 dia</td>
<td>56 dia</td>
<td>56 dia</td>
</tr>
<tr>
<td>Weight of cover and frame</td>
<td>38 Kg.</td>
<td>116 Kg.</td>
<td>116 Kg.</td>
<td>116 Kg.</td>
<td>116 Kg.</td>
</tr>
<tr>
<td>Type of Cover &amp; Frame</td>
<td>SFRC</td>
<td>SFRC</td>
<td>SFRC</td>
<td>SFRC</td>
<td>SFRC</td>
</tr>
</tbody>
</table>

All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

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.

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.

All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge. Weight of cover, frame and thickness of slab as given above.

All Rainwater Collection Chamber shall be of the size 50x45x60cm (internal) with horizontal C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge. The grating along with frame shall be of size 500x450mm grating having total Wt. of app. 38 Kg and of approved design and quality as per instruction of Engineer-in-Charge. The remaining details of construction shall be same as stated above for the construction of the Manholes etc.

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.

COMMISSIONING

After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary piping’s, labors, 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, wherever and as may be required.

Generally, the following test/inspection has to be carried out:-

- For any leakages/seepages in the external sewerage and drainage pipes.
- 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.
- 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.

DE-SALTING CHAMBER & RAIN WATER HARVESTING TANK

All Rainwater Collection Chamber shall be of the size 200x100x60cm (internal) complete as per drawing or as instructions of Engineer-in-Charge.

Rain water harvesting pit is constructed preferably 5 to 10m from the permanent structure. The bore will be excavated manually or drilled by reverse direct rotary method up to the water level or as per instruction of Engineer-in-Charge.

The dia of Rain water harvesting pit shall be 3000mm. Pit shall be filled with boulders, gravel and coarse sand.

Bore shall be 250mm dia and pipe shall be 160 OD uPVC 6 kg/cm². The pipe placed in the center of the shaft touching the lowest portion of the pit. The overflow pipe from the desalting chamber is directly connected to the rain water harvesting pit so that the rain water freely enters the pit for recharging. In addition to the inlet pipe from desalting chamber an overflow pipe at the ground level so that any excess water that enters the pit is automatically drained away without damaging the pit.

SECTION – VIII: HANDING OVER PROCEDURE

DOCUMENTS SUBMISSION

The Contractor shall before finally handing over the completed work in his scope to the Owner, submit the documents as per the Contract and as directed by the Engineer-in-Charge. Given below the checklist for the reference of the Engineer-in-Charge.

<table>
<thead>
<tr>
<th>Packages/ Sanitary Fixtures</th>
<th>Soil, waste &amp; vent pipes</th>
<th>Water supply system</th>
<th>Sewerage/ drainage system</th>
<th>Water tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final cleaning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>List of inventory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training Conducted on</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Operation Manual</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Maint. Manual</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>As built P&amp;I Diag/ SLD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defects Liability Period/ Warranty</td>
<td></td>
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<td>Commissioning report</td>
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<td>Test reports/ Certificates</td>
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<td>List of essential spares</td>
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<td>Address/ Contact nos. of Vendors</td>
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SECTION – IX: HOT WATER GENERATORS

STEAM GENERATORS

Scope
The scope of this section comprises the supply, erection, testing and commissioning of steam generator & allied equipments conforming to these specifications and in accordance with requirements of the system.

a. The steam boiler is to be a fire tube fully automatic oil fired packaged boiler developed tested and proven under rigorous conditions and subject to the strictest quality control procedures.

b. The Boiler shall confirm to the IBR standard for design and manufacturing of shell type boilers. All components and processes used in the manufacture shall comply with the requirements of the Indian Boiler Regulations.

c. Ample furnace and combustion volume shall be provided to ensure complete combustion.

d. A large heating surface is to be provided in the radiant zone to allow effective heat transfer.

e. Heat flux is to be kept to a bare minimum by providing adequate total heating surface, to limit the scale formation on heat transfer area.

f. The Boiler shall have a three pass flue path. The first pass shall be the furnace, whereas nests of smoke tubes are to form the 2nd and 3rd passes. At the end of the furnace a wet back type combustion chambers are to be provided, to allow the reversal of the flue gas and direct it to second pass tubes.

g. The fire tubes in the tubes nest are to be plain without any restriction inside to reduce pressure drop and maintenance issues. The tubes are to be easily accessible both from inside as well as outside for inspection and maintenance. The required number of stay tubes and stay bars are to be fitted in the boiler.

h. A reversing chamber at the front of the boiler shall transfer the flue gases from the second pass to the third pass of the boiler. The flue gas outlet shall be positioned at the rear side of the boiler just after the third pass.

i. All working parts of the boiler are to be accessible for ease of inspection and maintenance. On the shell, adequate Man Access Doors are to be provided. Access to the combustion chamber is to be through a bolted refractory lined access door whereas tube nest is to be exposed through hinged mounted front door and bolted covers on back casing plate.

j. The Boiler shall be fitted with a Pressure Jet burner and the Burner shall be capable of firing furnace oil up to 3500 Red. Sec. 1 at 1000 F viscosities. The burners are to be fitted with FD fan, spark ignitors, oil heater, gear oil pump, flame surveillance system and damper motor assembly.

k. The control panel shall be a part and parcel of the boiler. It shall contain all switchgear, safety alarms/interlocks and burner management system. For water level control in the shell a magnetic level switch along with a separate override unit shall be provided to ensure positive level shut off fuel supply to burner under extra low water level and puts the boiler under lock-out till the fault is rectified.

l. The control panel of the boiler shall include burner management sequential controller with self-diagnostic features to help quickly locate faults in boiler operation.

m. All required fittings/mountings as described below are to be provided for safe and trouble-free operation of the Boiler.

n. The Boiler Shell shall be Factory Insulated and the insulated cylindrical shell of the boiler is to be a heavy gauge sheet metal covered frame, which not only provides neat appearance but also protects insulation material properties.
a. **Pressure Parts:**
- Boiler Shell
- Tube Plates
- Furnace Flue
- Combustion Chamber
- Boiler Tubes
- Stays ( Tubes, Bars, Gussets)
- Access door on tube plate
- Man Access door
- Stand pipes for Stop, Feed check, Safety and Blow down Valves
- Stand pipes for gauge glass and level controller

b. **General Construction Parts:**
- Front casing with hinged door
- Rear casing with removable doors
- Flue outlet flange
- Insulation and sheeting for boiler shell
- Rear access door refractory
- Support base frame

c. **Mountings:**
- Safety Valves (2 nos)
- Main Stop Valve (1 no)
- Feed check Stop Valve (2 nos)
- Feed check NRV (2 nos)
- Blow down Valve (1 no)
- Water Gauge Glass (1 set)
- Water level controls (2 sets)
- Pressure gauge (1 no)
- Inspector’s test connection (1 no)

d. **Combustion Equipment:**
Fully automatic pressure jst design burner fitted with F. D. Fan, air / fuel ratio adjusting damper, pressure and temperature gauges, thermostat, Spark Ignitor and flame surveillance sensor.

e. **Feed Pumps:**
2 nos. electrically driven centrifugal multistage pump with motor, interconnected pipe work between pumps and feed check valves.

f. **Instruments and Control:**
- Blow down valve
- Main steam pressure gauge with cock.
- Level controller for feed pump operation and low water level alarm.
- Over-ride controller for lockout under extra low water level alarm.
- Pressure control switches.
- Flame surveillance and burner management controller.
- All switch gears, relay, connectors.
- Audio / visual alarm in case of unsafe operation for lockout under extreme conditions.
- Pressure and temp gauge with thermostat for burner.
• Control panel housing above instruments and switch gears.

g. **General Items:**
   • Operation and maintenance instructions.
   • Feed water piping between feed check valve and pump outlet.
   • Pressure gauge tubing.

**Fuel Oil Piping**

**Scope**
The scope of this section comprises the supply and laying of pipes, pipe fittings and valves testing and balancing of all HSD piping required for the complete installation as shown on the drawings. All piping inclusive of fittings and valves shall follow the applicable BIS Codes. The HSD Bulk Fuel Storage Tank is supplied by others. Contractor shall arrange to take a tap off from the HSD transfer pump discharge for his service (Day oil) Tanks. The tap off shall be provided by level sources in the Day oil Tank.

Overflow from the Day oil Tanks shall be led to energy overflow Tank altered to a pump to transfer the overflowed HSD back to the Buck fuel Tank.

The overflow Tank shall be provided with an automatic pump start/stop level controller which will also be capable of providing an audio visual alarm indicating overflow.

All Electrical components used shall be roted for HSD duty and flow proof.

a. Pipes shall be MS class ‘C’ & fittings shall be welded type fittings conforming to relevant BIS codes. All jointing in the pipe system shall generally be by welding / flanges, unless otherwise mentioned or directed at site. All welding shall be done by qualified welders and shall strictly conform to BIS code of procedure for manual metal arc welding of mild steel.

b. All pipes and their steel supports shall be thoroughly cleaned and given on primary coat of red oxide paint before being installed. All welded piping shall be subject to the approval at site.

c. Thread joint fittings shall be malleable casting of pressure rating suitable for the piping system. Fittings used on welded piping shall be of the weldable type.

d. Tee-off connections shall be through equal or reducing tees other-wise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

e. Valves, conforming to the following specifications, shall be provided as shown on drawings.
CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGARH, ORISSA

<table>
<thead>
<tr>
<th>Size</th>
<th>Construction</th>
<th>Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 to 40 mm</td>
<td>Gun Metal</td>
<td>Screwed</td>
</tr>
<tr>
<td>50 mm over</td>
<td>Body cast iron spindle and valve seat Of bronze or gun metal</td>
<td>Flanged</td>
</tr>
</tbody>
</table>

All valves shall be heavy duty.

f. Flanges shall be approved make. The supply of flanges shall also include supply of bolts and nuts and suitable asbestos fiber / rubber insertion gaskets (minimum 3 mm thick).

g. Non-return (check) valves shall be provided as shown on the drawings, conforming to relevant BIS codes and in accordance with the following specifications:

<table>
<thead>
<tr>
<th>Size</th>
<th>Construction</th>
<th>Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 to 40 mm</td>
<td>Gun Metal</td>
<td>Screwed</td>
</tr>
<tr>
<td>50 mm over</td>
<td>Cast Iron / Gun Metal</td>
<td>Flanged</td>
</tr>
</tbody>
</table>

Swing check valves shall normally be used in all services. Lifts type valves may be used in horizontal runs.

h. The strainers shall be of cast iron body with gunmetal or bronze mesh for fine filtration of the oil.

i. All piping and fitting shall be pressure tested, then painted and shall be provided with additional weather proof treatment for buried pipes.

j. All piping shall be painted as specified herein. After piping has been installed, tested and run for at least three days of eight hours each, all exposed piping and pipe supports shall be given two finish coats, 3 miles each, of approved paint, conforming to relevant BIS codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows.

Steam Generator Performance Test

Following listed tests shall be conducted after installation of the boiler:

a) Capacity test to confirm 600 Kg/Hr from @ 10.5 kg/sqm and at 100 deg. C
b) Dryness fraction test to confirm 0.95 dryness at full load.
c) All controls and safety test.
d) Efficiency test to confirm maximum 88% on N.C.V. (at specified fuel consumption)
e) Safety valve blow test.
f) Hydraulic test.
Steam Generator Inspection

Contractor shall arrange the inspection and dry trial at works of the Steam Generator prior to dispatch if so required by the Owners.

Drawings
Contractor shall furnish following drawings in triplicate within two weeks from the date of order to the consultants.

a) Foundation details of each Steam Generator.
b) Steam Generator electrical wiring diagram.
c) Steam Generator operation manual.
d) P & I diagram.
e) General arrangement & Terminal point details.
f) Proposed Layout Of Boiler House.

Warranty

Contractor shall furnish a guaranty of 12 months from the date of commissioning and testing against faulty design, materials or workmanship. During guaranty period supplier is bound to replace the defective parts free of cost.

Precommissioning

On completion of the entire erection of equipment, piping, connection to the pipe system and electrical system, contractor shall fill the entire system with cold water and test for leakage and other erection defects. All such defects shall be removed. All motors shall be test started.

Commissioning & Testing

On completion of all procedures at pre-commissioning stage, Steam Generator shall be fired by the respective supplier, and all adjustments shall be carried out in valves and other accessories for all related equipments. Steam Generator shall be allowed to run till the desired pressure & temperature in the system is obtained. Any defects noted shall be rectified immediately.

Installation Instructions

On completion of installation, commissioning and testing, contractor shall provide services of their technical staff to train the Owner’s staff in operating day to day maintenance of the installation for a period of 15 working days.

a) Contractor shall provide six sets of completion drawings showing “As-installed location of all heat exchangers, equipment piping and valves. One copy of the drawing shall be mounted on a glass frame and fixed in Steam Generator room.
b) Contractor shall provide six sets of erection and maintenance manual of all equipment supplied and erected by him. The manual shall include information regarding model No., Year and manufacturer and manufacturers name, manufacturer representative’s name and address. The manuals shall be bound in stiff covers. Necessary IBR certificates /Inspection report all registry books.
c) Contractor shall perform such tests that may be necessary and required and as directed by Project Engineer to test the rated capacity of the equipment.
d) The Contractor shall advise owners operators regarding feed water treatment and give the requirement of chemicals and dosing schedule for smooth and trouble free operation of the system.

The Contractor shall make arrangements to have the Boilers and its Installation completed and approved by the Boilers Inspector. The Installation shall be handed over as a complete ready to operate and approved installation.

The steam and condensate recovery system shall be designed by

**Technical Information**

The contractor shall fill in the following technical data:

**DESCRIPTION**

**STEAM GENERATOR**

Steam Generator

Rated output in Kgs/Hr : 

a) Overload factor :

b) Make :

c) Overall dimensions :

d) Dead Weight (Empty) :

e) Dead Weight (Operational) :

f) Volumetric Capacity of shell :

Type of Steam Generator

a) Designed working pressure :

b) Total heating surface :

c) Heat exchange ratio :

d) Fuel consumption per hour (HSD) :

**Efficiency**

a) Overall (ON NCV) :

b) Dia of smoke outlet. :

c) Temp. of gases leaving stack at full load :

d) Size of combined flue. :

e) Static pressure at stack. :

f) CO2 at outlet of Boiler :

**Details (Size, Make of the Boiler Mountings Offered)**

a) Inlet valve for feed water :

b) Outlet valve on top for primary Flow (main steam stop valve) :
c) Auxiliary outlet valve & blow Down valve :

d) Horizontal check valve :
e) Safety Valve :
f) Any other accessory offered. :

Oil Firing Equipment

a) Make :
b) Model No. :

Flue Gas Details

Capacity of Firing

a) Type and size/HP of air blower :
b) Capacity of blower :
c) Size of oil inlet line :
d) Size of oil return line :

Boiler Feed Tank

a) Size :
b) Thickness of sheet :
c) Capacity :

Piping For Steam Generators

Piping

All Boiler pipes and accessories will the pressure is reduced to 1kg/cm², shall be IBR and approved by the Boiler Inspector. The entire installation shall be approved by the Boiler Inspector.

All steam pipes shall be M.S. heavy class pipes conforming to IS: 1239 part I with heavy class pipe fittings. All fittings shall be weldable type. The pipes shall be properly ground at the ends to make a vee. The two pipes before being welded shall be placed on the vee block, properly aligned. A gap of 2-3 mm shall be maintained between the two pipes and V butt welding done. All welding flux material of the root run shall be removed using metal brushes. The final welding shall be done over the root run forming a proper bead of the welding.

Flanges

All M.S. flanges shall be raised face, slip on type conforming to class ASA 300 and shall be of welded neck type.

Gaskets

The gaskets shall be made out of the fire retardant material. The gasket material shall preferably be minimum 3 mm thick compressed asbestos capable of withstanding minimum 600 degree centigrade temperature.

Nuts, Bolts & Washers
All nuts & bolts shall be of high tensile M.S. The length of the bolts shall be such that about half an inch of bolt shall protrude outside the face of nuts. In all nut & bolt joints, washers of suitable sizes shall be used on the bolts as well as nuts side.

Valves
All valves used for steam piping shall be globe valves of class 150. All valves shall be of cast steel or forged steel with gun metal or SS trimmings. Globe valves shall conform to API 602/600.

Steam Traps
The steam traps shall be either thermodynamic or inverted bucket/Float type & depending upon the application and for draining the condensate from the main stream line or branch line. Steam traps shall also be provided with strainer and bypass arrangement. The body of inverted bucket steam trap shall be of cast steel. The body material for thermodynamic steam traps shall be of stainless steel.

Safety Valves
Safety valves shall be of high lift type with casing lever, for manual flow. The material shall be of bronze/cast steel.

Pipe Line Supports & Pipe Layouts
Pipe line supports shall be installed in a manner so that the pipe line is free to move as a result of expansion or contraction. Steam lines should be arranged with a fall in the direction of flow. A fall of around 40 mm in 10 M shall generally be provided. Drain points shall be provided at every 30 to 50 M interval. Drain points shall also be provided at any low points where condensate can collect. Branch connections should always be taken from the top of any main. Drain points shall preferably be provided wherever pipe work changes direction, when drainage has to be provided in a straight length of pipe then a large bore pocket should be provided. Concentric reducers shall be avoided and eccentric reducers shall be used.

Allowance for Expansion
Wherever there are long runs of straight pipe some provision for expansion must be kept. Horse shoe or lyre loop/sliding joints must be used to take care of expansion.

Steam Piping Insulation
Steam piping insulation shall consist of following:

a) Application of heat resistant paint.

b) Application of preformed pipe section of glass wool of thickness as specified in the schedule of quantities and having density not less than 80 Kg/Cubic M.

c) Covering the insulation with chicken mesh & hessian cloth.

d) Covering the insulation with 24 gauge ribbed aluminum sheet cladding and fixing in position with a self tapping screws at 150 mm centre. All joints shall be overlapped by 50 mm and arranged to shed water.
DAY OIL TANK

Type

The capacity of fuel tank is actual useful capacity viz the storage between the drain level and overflow level, with zero level marking on the gauge starting from drain level.

Construction

a) The tank shall be fabricated from min 4mm thick MS sheet.
b) The fuel tank top shall be fully bolted type and shall have a bolted type inspection manhole cover with a handle, so that ordinary inspection and minor cleaning of tank can be carried out.
c) The top cover & inspection cover fitting shall be so as to make it water proof, fitted with min 5mm thick neoprene rubber gasket.
d) In case of floor mounted tanks the tank shall have fabricated footing on four corners so that the bottom of fuel tank is atleast 150mm above resting level or floor level, to enable cleaning of space below, drain the tank etc.
e) In case of structure mounted high level day tank, instead of footings an appropriate channel base shall be provided.
f) Fire safety requirement to be integrated for the Day oil Tank.

Fitments

a) The tank shall have appropriate fitments as mentioned below
   i. Filling connection
   ii. Fuel feed connection.
   iii. Fuel returns connection.
   iv. Air vent
   v. Drain valve with plug & sampling nozzle.
   vi. Overflow Pipe.
   vii. Fuel level gauge.
   viii. Low fuel level alarm.

b) The drain valve shall be of min 25mm dia, industrial type only. Audco valve or similar construction and quality only is to be provided to provide reliable, drip proof system. Commercial quality gun metal or brass valves are not acceptable.

   The drain valve shall be located preferably at the bottom most level in front at either corner so that complete & thorough draining for cleaning purposes is possible.

   To give a proper slope, about 10mm thick flat plates shall be welded so that when the tank is placed on that floor a gentle slope towards the drain cock is available.

   The actual location of drain cock & fuel level gauge should be such that a drip tray could always be placed below these fitments to prevent diesel spilling accidentally or during maintenance operation.

c) The fuel level gauge glass shall consist of two right angle nozzles, to which good quality transparent heavy gauge alkathene/PVC pipe (flexible type) could be tightly inserted. The pipe so fitted shall be in perfect vertical alignment. Shut off cocks should be provided at the top & bottom. The pipe should be protected in a SS tube with a cut to allow.
A calibrated, 3mm thick aluminium scale shall be screw fitted behind the pipe so that the level in mm & liters can be readily read. The scale markings shall be engraved type with red paint filled, readable against white background.

After the construction of tank, the quantity in liters shall be established on the scale by filling water in measured quantities i.e. actual calibration shall be done.

d) The fuel feed connection shall have fine mesh screen filter or diesel filter, micro porcelain type for HSD day oil tanks & duplex filter of 100 micron filtration for boilers feed day oil tanks so that only clean filtered diesel goes in the fuel feed pipe going to the equipment. The screen mesh filter/diesel filter/duplex filter should be easily accessed for cleaning and external fitment of these is preferred.

The fuel feed pipe shall be so provided that this feed is only at 150mm above the bottom, to prevent water and settled impurities getting into fuel feed pipe system.

e) In case of high level tank system MS supporting structure welded type of adequate height, rung ladder with hand rails, & platform with chequered plates shall be supplied to form a complete system. The erection of these structures etc., forms the scope of work of vendor. About 0.75M space around the tank at least on 3 sides at the level of tank should be present for ease of operation & maintenance.

Further the drain of tank shall be brought down to an approximate level of 1M above G.L. by well laid out piping system with drain valve & cock provided at this level.

**Painting**

The day tanks, after fabrication & calibration shall be thoroughly cleaned & spray painted with two base coats plus two finish coats of special diesel resistant paint.

The supporting structure also should be cleaned & painted with two coats of base primer and two coats of enamel paint.
SECTION – X: SEWAGE TREATMENT PLANT (STP)

SCOPE

Work under this Contract consists of

Detailed engineering design of all plan areas, section, Civil, Structural, mechanical, electrical and piping systems according to the current and applicable BIS codes as applicable. The proposed plans of the STP shall be subject to the approval of the Architect / Consultant.

Design, manufacture, assembly, installation, testing and commissioning of the main treatment units in RCC tanks, mechanical equipment for the packaged type Sewage Treatment Plant (STP) of capacity and design parameters given in BOQ & specifications broadly comprising of:

- Diffused aeration system comprising of non-metallic piping submerged diffusers to be provided in the RCC equalization tank, MBBR unit, and sludge holding tank.
- Twin lobe air blowers with belt drive, electrical motors, piping headers, piping connections to all units.
- Pumping sets from equalization tank to STP, effluent, post filtration and final effluent disposal pumps as per design requirements.
- Final effluent pressure filters, softener pumps for final disposal / reuse.
- Motor control centers, cabling from MCC to all units, all instrumentation, and measuring devices and earthing of equipment. All electrical works to be carried out guidelines as per detailed annexure enclosed.
- Instrumentation and chemical test kit as specified.

Drain channel, sump with a drainage submersible pump (1 working + 1 standby) with pipe work, valves and discharge pipe up to nearest external manhole in plant room shall be provided by others.

Provide PH Meter, Electronic magnetic flow meter in inlet & outlet of filtration system

The Work Includes

- Civil, Mechanical & Electrical works
- Piping as specified.
- Testing, commissioning and operation of plant with water and under load conditions.

Construction of all architectural, civil and structural works related to the construction of the building, its internal lighting, sludge disposal system.

Incoming power connection, electrification of pump house.

Incoming sewer / rising main connection to the plant.

Connection from final effluent tank / pump to point of use for reuse or for disposal in accordance with approval of the State Board for Prevention and Control of Pollution.

Shop Drawings
The contractor shall submit shop drawings as follows:

- On award of the work, he shall submit GA drawing, PIB diagrams, plant layout with basic dimensions, flow diagram with levels of elements.
- Fabrication and equipment layout piping, valves and all other information required for installation.
- Electrical layouts, detail of all MCC, cable sizing and system diagrams and earthing system.
- Piping layout with pipe dia. slopes, fixing arrangements.
- Three copies of the shop drawings shall be submitted for initial scrutiny. On approval of the same contractor shall submit six copies of the same incorporating corrections etc. Two sets will be stamped “GOOD FOR CONSTRUCTION” by the Consultant and returned to the contractor.

**Other Submittals**

Contractor shall furnish four sets of folders giving:

- Catalogues and technical information sheets of equipment to be installed.
- Performance curves, foundation details and fixing arrangements.

Contractors proposal for testing procedures for individual equipment and for overall testing of the plant.

Submittals shall be separate for:

- Mechanical and Piping works
- Electrical Works

All shop drawings and submittals mentioned above shall be approved by Architect and two sets duly stamped shall be returned to the contractor for execution of the works.

**Execution of Work**

All work shall be executed only in accordance with the approved shop drawings and other submittals. Contractor shall ensure that all inserts, support plates, puddle flanges and other items required to be incorporated during execution shall be placed in position as per his own requirements during execution of the works.

All special tools and tackle required for erection and assembly of the equipment covered by the contract shall be obtained by the contractor himself. All other materials such as foundation bolt nuts, etc. required for the installation of the plant and equipment shall be supplied by the contractor and are part of the contract.

**Testing & Handing Over**

The contractor shall carry out tests on different equipment as required in the presence of the Consultant or his representative in order to enable him to determine whether the plant, equipment and installation comply with the specifications, local codes and in accordance with the letter and intents of the specifications.

The installation shall be handed over to the Engineer-in-Charge only on successful completion, operational tests and acceptance of the effluent quality by the municipal / pollution control and statutory authorities.

**Statutory Permissions**
Contractor shall submit a write-up of process of the plant, drawings, design parameters flow and PIB diagrams as necessary and required for submission to the State pollution control authority.

Contractor shall furnish at his own cost, analysis of influent at source (for evaluation) as well as that of influent at the holding tank of the STP and the effluents from the STP for submitting to State Pollution Control Board and any other statutory authority whose approval is required.

Contractor shall perform all testing and operation of the plant in presence of the Pollution Control Board if so stipulated by them.

Contractor to obtain all statutory approval as required for PCB or any other approval. Only official fee will be reimbursed to contractor by the Owner.

**Completion Documents**

On successful completion of the entire work, the contractor shall submit 4 sets of following documents to Architect.

A brief write-up of process, day to day operating and maintenance instructions.

List of approved chemicals and procedure for storage and safety norms.

Completion drawing and data, catalogues, performance charts, technical data sheets and equipments installed.

Manufacturer’s maintenance and operating instructions for mechanical and electrical equipment.

Laminated and framed “As Built” drawings with plans, section, process flow diagrams, pipe runs, levels and final disposal point schedule of equipment installed with all their model Nos. plate data and date of installation.

Test readings of Influent & Effluent parameters taken at final handing over time

NOC (No Objection Certificate) from State Pollution Control Board and any other statutory authority whose approval is required.

**Performance Guarantee**

Equipment supplied and installed shall be guaranteed to yield the specified effluent standards which must meet and accepted with the requirements of Pollution Control Board.

The guarantee implicitly includes replacement of the entire plant on failure to meet desired effluent parameters, replacement of individual equipment or repairs as warranted. Decision on each and every aspect on this matter shall rest with the Consultant and shall be final and binding on the contractor.

**Defects Liability**

All equipment and the entire installation shall be guaranteed against defective materials and workmanship for a period of 12 months reckoned after taking over of system by Owner along with the documentation. During the defects liability period, the contractor shall replace defective parts and components free of cost. Rectification or repair may be permitted in case the defect is of minor nature.
Deviations from Tender Specifications

Tendered may indicate their comments only as deviations from the conditions stipulated herein. Wholesale submission of their own conditions and/or printed conditions in disregard of the conditions stipulated herein shall not be binding on this Tender.

No corrections, erasure etc. of this document shall be accepted.

Sewage Characteristics

Design Parameters

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<th>Parameter</th>
<th>Details</th>
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<tr>
<td>Project</td>
<td>Hospital Building</td>
</tr>
<tr>
<td>Usage</td>
<td>Office workers / Patient</td>
</tr>
<tr>
<td>Location</td>
<td>Under ground</td>
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<tr>
<td>Level</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Design Consideration

<table>
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<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity (Max.)</td>
<td>500m3/day</td>
</tr>
<tr>
<td>Area Available</td>
<td>350 Sqm</td>
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<tr>
<td>Operation</td>
<td>Domestic Sewage (round the clock)</td>
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<tr>
<td>Influent</td>
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</tr>
<tr>
<td>pH</td>
<td>7.5 to 8.5</td>
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<tr>
<td>BOD 5 days @ 200C.</td>
<td>upto 250-350 mg/l</td>
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<tr>
<td>Suspended solids (SS)</td>
<td>upto 250-400 mg/l</td>
</tr>
<tr>
<td>Oil &amp; grease</td>
<td>50 mg/l</td>
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<tr>
<td>COD</td>
<td>upto 450-600 mg/l</td>
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</table>

<table>
<thead>
<tr>
<th>Treated Effluent</th>
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</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6 - 7</td>
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<tr>
<td>BOD 5 days @ 200C.</td>
<td>less than 20 mg/l</td>
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<tr>
<td>Suspended solids (SS)</td>
<td>less than 10 mg/l</td>
</tr>
<tr>
<td>Oil &amp; grease</td>
<td>NIL</td>
</tr>
<tr>
<td>COD</td>
<td>less than 100 mg/l</td>
</tr>
</tbody>
</table>

Salient Features

The plant should be suitable for low/peak flow in line with medical waste usage.

The plant should not create any noise, with no nuisance on fly or mosquito and no foul odors.

The plant should work without the use of in-organic chemical additives.

The plant should be provided with tertiary treatment in form of duel media/activated carbon filter /UV system to provide zero bacteriological standards for reuse on:
Basis of Design
The capacity/rating of pumps and equipment etc. shall hold good for the capacity of 500 m3/day and shall be good for meeting the treated parameters requirement as follows:

- Manufacturer, use import and storage and hazardous Micro-Organizers, Genetically Engineered organizations or Cell Rules, 1989.
- Manual on sewage & sewage treatment - CPHEEO
- All standards as laid down by Central Pollution Control Board and any other relevant statutory authority.
- 100% recycle of waste water and removal of sludge in cake from, no water to be discharged outside the premises.

Sewage Treatment Plant

General

The sewage treatment plant (STP) system outlined in this section specifies the system design, manufacture, supply and installation of a standard MBBR (Moving Bed Biofilm Reactor).

The Contractor shall submit analytical test reports of effluent water samples after the commissioning or after the system is put into operation or as required by the Consultant.

The report shall contain analysis of all data related to those requirements laid down by the local Authorities.

The effluent from the Sewage Treatment Plant shall be suitably treated and the effluent water recovered shall be used for irrigation purposes/flushing system/cooling tower for D.G etc.

Description of Process
The treatment process shall comprise the following stages:

- Physical treatment: Fine bar-screening / Oil & Grease Chamber
- Equalization / Collection tank: Flow equalization with air mixing
- Biological treatment: MBBR based
- Final sedimentation: Settler tank
- Intermediate treatment: UV System in Intermediate tank
- Water reclamation: tertiary filtration and sterilization (For irrigation purpose, flushing or cooling tower make up)
- Sludge disposal: In cake form through Filter Press or (Transfer through a screwed type pump to municipal tanker)

Performance Criteria of the Plant
Raw sewage will be brought into the Sewage Treatment Plant. The Contractor shall receive sewage from this point to the treatment plant for treatment process.

The treatment plant shall be designed to treat the above basic characteristics expected in the raw sewage.

Treated effluent shall be connected to a tertiary filtration / Softening plant to treat and shall be use for irrigation purpose and Flushing/CT make up purposes.

**Process Description**

- **Inlet Screen Chamber / Oil & Grease Chamber**
  
  Raw sewage shall flow into the inlet screen chamber by gravity. Large solids particles shall be intercepted by a fine screen. Then there shall be Oil & Grease Tank. Sewerage will then flow into Equalization / Collection Tank The incoming sewage shall be mixed in the EQT and fine bubble aeration shall be maintained.

- **Equalization / Collection Tank**
  
  The equalization tank shall be designed to provide a minimum storage of 2 hours at peak flow while pumping. Submersible pumps as per specifications shall be provided with level switch control and automatic cut-in of the standby unit.

  An aeration system similar to the SAFF tank shall be provided for mixing and aerating the sewage.

- **MBBR Tank**
  
  Sewage shall be retained in the MBBR tank for a minimum of 4-5 hours and subjected to biochemical oxidation by fine bubbles aeration. The deck media shall be installed in the form of rectangular blocks & shall be fixed in the form of layers not more than 600 mm vertical height. The media shall be corrugated type & shall facilitate cross flow for better air distribution. The media shall be duly glued as per manufacturer’s recommendations.

- **Tube Settler Tank**
  
  The sewage after bio-oxidation shall enter the hopper bottom sedimentation tank where the sludge effectively settles to the tank bottom. The clear effluent shall weir into the Intermediate Tank for UV treatment.

  The activated sludge collected in the sludge tank shall be returned to the SAFF tank for further oxidation of the incoming organic matter. Excessive sludge shall be wasted in the sludge holding tank.

  PVC tube deck media is to be installed in Tube Settler Tank. The media shall install at 600 angles with the horizontal and the total vertical height when installed should be 750 mm. The media shall be duly glued using recommended material and shall be installed as per the drawing to be given by the vendor as per manufacturer’s recommendation.

- **Intermediate Tank**
  
  The effluent shall be retained in the baffle walled cleared water tank for a minimum of 30 minutes for effective disinfection prior to discharge through UV system.
• Sludge Holding Tank

Excessive sludge shall be stored in the sludge holding tank for final dewatering and disposal.

• Then will be Treated Water Tank (TWT)

• Also there will be Soft Water Tank (SWT).

Equipment

The following give the minimum requirements of the different components of the system.

All equipment and components of the system shall be of top quality construction and shall be corrosion resistant.

• Fine Screening Equipment
  Bar screen shall be of 304 stainless steel constructions. Drip trays shall be provided for holding and drainage of the screenings. A manual by-pass screen of 30mm opening with stainless steel drip tray shall be provided. An isolation valve shall be provided to divert the flow to the by pass screen when the screen requires service.

• Air Blowers
  Air blowers shall be provided with standby arrangement. Blowers shall be either of positive displacement or centrifugal with pressure vessel type complete with motor, base-plate, inlet filter, intake silencer and off-load starting system outlet silencer, anti-vibration damper, flexible coupling, filter restriction indicator, non-return valve, pressure relief valve, V-belt system or direct drive coupling. The casing rotor shall be of cast iron construction. Bearings and gears shall be grease lubricated. Motor speed shall be 1500 rpm.

  The size and performance of the air blower shall be so selected that it can provide a minimum airflow rate 0.5 l/sec / diffuser to 1l/sec/diffuser maximum, and to maintain a minimum of 2.0mg/dissolved oxygen in the aeration tanks in operation.

• Air Diffusers
  Air diffusers shall be made to provide a uniform distribution of fine bubble air release performance in the system. The air diffuser shall be either made of elastic rubber membrane or composed of crystalline fused aluminum oxide with a suitable ceramic bonding material.

  Membrane endurance shall be more than 180,000 expansion/contraction cycles.

  The Contractor shall submit calculation to justify the diffuser selection and air requirement during the detailed design.

• Sewage Pumps
  Working and standby sewage pumps shall be provided.

  Each shall be of submersible type c/w guide base to facilitate case of removal, lift chain and automatic discharge connection.

• Settling Tanks
  Settling tanks shall include baffles to prevent short circuiting.

• Ultra Violet (UV) System
UV system shall be furnished as a complete package assembly for installation in the plant room. Assembly shall include UV Lamps suitable no. UV dosing system shall perform to achieve a residue not more than 1 mg/l in the treated effluent. Feed pump shall have a maximum capacity of 1 l/hr will operate on 50 Hz supply.

- Tertiary Treatment
  This tertiary treatment shall be provided for the effluent used for irrigation and cooling tower make-up water tank/flushing system.

  The tertiary treatment plant shall comprise of the pressure sand filters and activated carbon filters. This shall be sized to accommodate 100% of the effluent discharge flow rate and shall achieve the performance as outlined and described in Design Criteria.

- Electrical Control
  The operation of the treatment process shall be fully automatic.

  A completely assembled and pre-wired control panel consisting of weatherproof cabinet shall be furnished. The control panel shall contain all metering and status indicators, motor starters, program timers, on-off-auto change-over switches and duty selectors for equipment.

- Other Equipment
  Any other necessary accessories, such as buffer, riser, scrub removal devices, partition, control panel, collection devices, etc. for all the tanks and pumps (where necessary) shall be provided in order to provide a fully working systems.

- Piping Materials

  - SS304: Submerged air piping
  - MS epoxy: Air piping and pumped effluent riser (Non submerged)
  - PVC piping: Pumped effluent (submerged) & tank overflow pipe line.

Valves

The Contractor shall supply and install all isolating valves and control valves as indicated on the drawings and as required for the proper and efficient operation and maintenance of the entire systems.

All valves supplied shall be suitable for the working pressure and test pressure of the system as specified elsewhere in this specification.

All valves shall be full line size.

Furnish all valves and accessory materials necessary in the piping whether or not shown on drawings as flows.

Plastic or metal plates (rustles) shall be provided to indicate the open / close status as well as the use of each valve in the pump and tank rooms.

PIPE SUPPORTS
General Support

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections,
details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pressure gauges shall be provided as shown on the approved drawings. Care shall be taken to protect pressure gauges during pressure testing.

INSTALLATION

The Contractor shall check the associated civil work prior to the installation of any item of machinery and advise the Consultant, in writing, of any deviation of such work from the specified details.

The machinery shall be accurately installed to correct dimensions, alignments, levels, etc., all as indicated on the final drawings. The machinery shall be mounted on flat steel packing pieces of thickness suitable to take up variations in level of the concrete foundations. Suitable packing pieces shall be located adjacent to each holding down bolt and shall be properly bedded by grinding the concrete surface to a smooth, level finish. The machinery shall be aligned and leveled and the nuts of the holding down bolts tightened with a spanner of normal length. The base plates shall be packed with grout after the machinery has been run and checked by the Consultant for stability and vibration.

Installation shall include the provision and fixing of all necessary holding down bolts, washers, nuts etc.

TESTING

The performance of the system shall be demonstrated by taking hourly samples of the raw sewage and final effluent over a twelve hour period. The sample shall be taken at periods approximately the flow rates specified by the plant. The sample shall be combined and a 5-day BOD shall be run, the results of which must verify the capacity of the treatment plant prior to acceptance.

ELECTRICAL INSTALLATION

MOTOR CONTROL CENTRES

Switchboard cubicles of approval type shall be fabricated from 2mm thick CRC sheet with dust and vermin proof construction. It shall be painted with powder coating of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall compromise of the following (Switchgear as given in the schedule of quantities):

- Incoming MCCB of required capacity.
- MCCB / MCB – one for each motor.
- Fully automatic DOL/Star Delta starters suitable for motor DOL upto 7.5 H.P.; Star / Delta for 10 H.P. and above H.P. with push buttons one for each motor and On / Off indicating neon lamps.
- Single phasing preventer of appropriate rating for each motor.
- Rotary duty selector switch
- Panel type ampere meters one for each motor shall be with rotary selector switch to road line currents.
- Panel type voltmeter on Incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.
- Neon phase indicating lamps and indicating lamp for each motor and on incoming mains.
- Rotary switch for manual or auto operation for each pump.
- Fully taped separate aluminum bus bar of required capacity for normal and emergency supply where specified.
- Space for liquid level controllers and other equipment specified separately in the contract / given in the schedule of quantities.
- The panel shall be pre-wired with color-coded wiring. All interconnecting wiring from incoming main to switchgear, meters and accessories within the switchboard panel. Wiring shall have suitable copper or aluminum ferrules.

Switchboard cubicle shall be floor or wall mounted type as directed by the Engineer-in-Charge.

SECTION – XI : REVERSE OSMOSIS SYSTEM FOR DIALYSIS

SCOPE & EXTENT OF WORK

Scope of Work

Work under this contract shall consist of furnishing all labor, materials, equipment and appliances necessary and required to supply, install, commission and operate a Localized RO with water cooler, as per BOQ.

RO Inlet water quality

Design and system manufacturing /assembling is entirely based on the following feed water analysis, assumed for design purpose. Please

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Raw water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Absent</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>≤ 2 mg/l</td>
</tr>
<tr>
<td>Turbidity</td>
<td>≤ 2 NTU</td>
</tr>
<tr>
<td>pH</td>
<td>6-8</td>
</tr>
<tr>
<td>Total hardness</td>
<td>≤ 500 mg/l</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>≤ 47 mg/l</td>
</tr>
<tr>
<td>Fluoride</td>
<td>≤ 1 mg/l</td>
</tr>
</tbody>
</table>
CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGARH, ORISSA

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica</td>
<td>≤ 10 mg/l</td>
</tr>
<tr>
<td>Iron &amp; Heavy Metals</td>
<td>≤ 1 mg/l</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>≤ 1000 mg/l</td>
</tr>
</tbody>
</table>

Schedule and Technical Details of Reverse Osmosis System Micron Filter

**Purpose**

To remove the fine sand particle up to 0.05 micron and reduce silt density index to acceptable level.

**Specifications**

- Cartridge filter & Housing
  
  - MOC of housing: PP
  - Length: 20"
  - Diameter: 6"
  - Quantity: 1 No.

- Cartridge:
  
  - Cartridge MOC: Polypropylene
  - Length: 20"
  - Diameter: 4"
  - Quantity: 1 No.
  - Micron rating: 0.5 micron

**Dosing System**

**Purpose**

To dose antiscalant chemical to protect the scaling formation on RO membranes.

**Specifications:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Tank Volume</td>
<td>ltr/hr</td>
<td>100</td>
</tr>
<tr>
<td>Max. Frequency Stroke per Min.</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Max. Back Pressure</td>
<td>l/h</td>
<td>1.08</td>
</tr>
<tr>
<td>Max. Back Pressure</td>
<td>@ Bar</td>
<td>12.0</td>
</tr>
<tr>
<td>Nominal Back Pressure</td>
<td>l/h</td>
<td>1.38</td>
</tr>
<tr>
<td>Nominal Back Pressure</td>
<td>@ Bar</td>
<td>6.0</td>
</tr>
</tbody>
</table>
### High Pressure Pump

**Purpose**
To feed the reserve Osmosis Membrane at pressure more than the osmotic pressure Taking consideration flux rate, flow & recovery.

**Specifications**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOC</td>
<td>STAINLESS STEEL</td>
</tr>
<tr>
<td>TYPE</td>
<td>VERTICAL MULTISTAGE</td>
</tr>
<tr>
<td>FLOW RATE</td>
<td>5000 LITERS PER HOUR.</td>
</tr>
<tr>
<td>HEAD</td>
<td>150</td>
</tr>
<tr>
<td>POWER REQUIRED</td>
<td>1.2.KW</td>
</tr>
<tr>
<td>ELECTRICAL</td>
<td>220VSINGLE, 50 HZ</td>
</tr>
<tr>
<td>CYCLE</td>
<td>2900RPM</td>
</tr>
</tbody>
</table>

### RO Membrane

**Purpose**
To remove the major part of TDS up to 98% by Reverse Osmosis Membranes arranged & designed to give adequate flow & recovery

**Specification**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Spiral Wounded</td>
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<tr>
<td>Diameter of Membrane</td>
<td>8.0 inch.</td>
</tr>
<tr>
<td>Length of Membrane</td>
<td>1MT.</td>
</tr>
<tr>
<td>No of Membranes</td>
<td>4</td>
</tr>
<tr>
<td>Recovery per Membrane</td>
<td>10-15 %</td>
</tr>
<tr>
<td>Salt Rejection per Membrane</td>
<td>98-99 %</td>
</tr>
<tr>
<td>Systems Recovery</td>
<td>60%</td>
</tr>
</tbody>
</table>

### RO Pressure Tube

**Purpose**
To pack Reverse Osmosis Membranes & operate at High pressure unto 250psi
Specifications

MOC : SS/ FRP Composite
Diameter of Pressure vessel : 8.5 inch
Length of pressure vessel : 2.5 meter
No Pressure Vessels : 2
No of Membrane per Vessel : 2
Position : Horizontal, Series

RO Cleaning System

Purpose

We provide a flashing system, which shall help to clean the Membrane & get deposited on the membranes.

Flushing Time : 15 Minutes.
Flushing Media : Treated water/Chemical
Flushing Tank Size : 100 litre
Tank MOC : HDPE
Flushing Pump : Raw water pump will used
Semi automatic with two ball valves operation.

Electrical Panel

Purpose

A control is provided as a safety measure for the Pump & other electrical items.

Specification

- Complete Starters Overload relays & single phase Preventer for pump.
- Voltmeter, Ammeter, MCB’s indicating lights.
- Push buttons. Rocker Switches for Dozers

Instrumentation

Purpose

Flow Meter : To measure the online flow of water
TDS Meter : To measure the online TDS of water
Low pressure Switch : To protect Ro pump from dry running.
High Pressure Switch : To protect RO pump from back pressure.
Pressure Gauges : For calculate the pressure for each unit in RO system.
Rota Meter : Quantity: 2 Nos. (permeate & reject line)
Range : 2.4cum per hour

Digital TDS Meter

Quantity : 1 No (Off line)
Range : 10,000 ppm

Pressure Switch :
Quantity : 2 No (Low & high)
Range : 0-450psi

Pressure Gauges :
Quantity : 6 No
Range : 0-7 Bar.
Dial Size : 2 inches
Type : Bourdon

Plumbing & Fittings

Valves, pipelines before Ro module is in upvc (16 bar tested) & CPVC after HPP, till the permeate line termination point.
NRV’S pressure relief valves, wherever needed the system will be on common MS base frame.

SECTION – XII : FIRE FIGHTING SYSTEM

TECHNICAL SPECIFICATION

Work under this sub-head consists of furnishing all Labor, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the

Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the followings:

• Providing M.S. black steel (Class C) pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Painting of pipe and Making Connection to supply system.
• Black Steel Pipe, Mains Laterals, Branches, Valves, Hangers and Appurtenances.
• Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets, Sprinkler heads and Landing Valves.
• Portable Fire Extinguishers
• Fire Fighting Pumps, diesel operated pumps, panels and all connected accessories including suction & delivery pipes.
• Testing Commissioning and giving live demonstrations to the various Inspection Authorities and Obtain their “No Objection Certificate” (NOC) for occupation of the building.

GENERAL REQUIREMENTS

All materials shall be of the best quality conforming to the Specifications and subject to the approval of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in shaft, passage etc.

Pipes shall be securely fixed to walls and by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCCs.

Valves and other appurtenance shall be so located that they are easily accessible for operation, repairs and maintenance.

PIPES

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:

• Pipes 150 mm dia and below IS: 1239 (Class C) Heavy Class
• Pipe 200 mm dia and above IS 3589 of thickness specified.

PIPE FITTINGS

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality.

Fabricated fittings shall not be permitted for pipe diameters 50 mm and below.

When used, they shall be fabricated, welded and inspected in workshops under supervision of Engineer-in-Charge whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

JOINTING

Screwed (50 mm dia pipes and below)

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 MS forged fittings)
Welding (65 mm dia and above)

Joints between MS 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 rectifier of required current and capacity. The vendor for welding will be approved by Engineer-in-Charge.

Flanges

Flanged joints shall be provided on:

- Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of with 3 mm insertion neoprene gasket complete.

Unions

Provide Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

PIPE PROTECTION

All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.

All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.

PIPE SUPPORTS

All pipes shall be adequately supported from or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.

Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and s by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

TESTING

All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 kg/cm² without drop in the pressure for at least 2 hours.
Rectify all leakages, make adjustment and retest as required.

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).

VALVES
Valves, Gauge and Orifice Plates

Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves up to 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 kg/cm² class-II as per I.S: 778-1971. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.

Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

EXTERNAL YARD HYDRANTS

The Contractor shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S of size 76.8 x 61.44 x 25.80 cm, as approved by the Architect to equip 2 nos. of 63 mm dia controlled percolating hose and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the Engineer-in-Charge / Architect.

INTERNAL HYDRANTS


A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.

The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

FIRST-AID HOSE REEL EQUIPMENT

First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall confirm to IS:1532-1969.
The hose tubing shall be 20 mm dia and 36.5m long. The GM nozzle 5mm and globe valve shall be of 20 mm size.

The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the MS pipe riser taken independently from ring.

**HOSE PIPES, BRANCH PIPES AND NOZZLES**

**Hose Pipes**

Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall confirm to type A (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

**Branch Pipe**

**Branch Pipes**

Branch pipe shall be of Gunmetal 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

**Nozzle**

The nozzle shall be of Gunmetal 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

**HOSE CABINET**

The internal hose cabinet shall accommodate the Hose pipes, branch pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge MS/aluminum sheet. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

The hose cabinet shall be painted red and stove enameled and woods FIRE written in front glazed portion.
FIRE BRIGADE INLET CONNECTIONS

Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified, for the following purposes:

- Fire Brigade suction connection for fire static tank with provision of foot valve.
- Fire brigade inlet connection to fire static tank.
- Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of Sluice valve and Non return valve.

The locations of this Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

HYDRAULIC SIREN

A siren shall be provided in the system, to indicate the flow of water in the wet riser system. Alternative arrangements may also be adopted. This shall be turbine type.

VALVE CHAMBERS

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.

Valve chambers shall be of following size:

- For depths 100 cm and beyond 90x90x100 cm

PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per the drawing and shall confirm to IS:2190-1979.

- Two 9 lit. water CO2 type for every 600 m2 area with minimum of 1 extinguishers per floor as per IS:15683
- Dry Chemical powder type of 6 Kg. Capacity as per IS:15683
- CO2 type of 4.5 kg capacity as per IS:15683.

SPRINKLER HEADS

Sprinkler heads shall be provided at approximate spacing to cover 9 to 12 m2 per Sprinkler head. The spacing shall however, be in conformity with the drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the.

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.
Contractor shall supply spare Sprinkler Heads of each type as per requirement and one Spanner for each type of sprinkler neatly installed in a steel box with glass shutters at locations approved by the Engineer-in-Charge.

ALARM VALVE & AUTOMATIC WATER MOTOR GONG VALVE
The alarm valve & water motor gong valve UL approved shall be provided on the Sprinkler main delivery pipe complete in all respects.

SHOP DRAWINGS & SPECIFICATIONS
The Contractor shall submit to the Consultant two copies of Shop Drawings for Fire Fighting works as an Advance Copy to the Engineer-in-Charge 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 Engineer-in-Charge. Also the Contractor shall submit four copies of the Technical Specifications and Catalogues.

Shop drawings shall be submitted for the following conditions:

- Structural supports/hanging/laying and jointing details for all types of pipes as required.
- Fire Fighting layout plans as required and for any changes in the layout of Fire Fighting/Architectural drawings.

The Contractor can only commence the work after the approval of above documents by Consultant.
SECTION – XIII: WATER SUPPLY/FIRE FIGHTING PUMPS & EQUIPMENTS AND WATER TREATMENT UNITS ETC.

PUMPS AND WATER TREATMENT EQUIPMENT

Work under this sub-head consists of furnishing all labor, materials, equipment and accessories necessary and required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter.

Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

- Raw water pumps.
- Hydro pumps for Domestic water.
- Soft water transfer pumps.
- Garden Hydrant Pumps.
- Hot water recirculation pumps.
- Treated water supply pumps to STP (Emergency supply)
- Sump pumps for disposal of sewage and drainage.
- Water treatment unit consisting of filter, softener and chlorination etc.
- Fire pumps.
- Motor control panels, power and control cabling and allied electrical works.
- Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

PUMP SET

Water Supply Pumps (Raw Water / Soft Water / Garden Hydrant / Hot Water Recirculation Pump)

Water supply pumps shall be suitable for clean water. Pumps shall be multistage, monoblock vertical centrifugal pumps with Cast Iron body and Cast Iron impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling. Each pump should operate a curve 10m below specified head.

Pump and motor shall be mounted on a common M.S. structural base plate or as required as per site conditions.

Each pump shall be provided with a totally enclosed fan cooled induction motor.

Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal “Burden” type pressure gauge with gunmetal isolation cock and connecting piping.

Provide vibration-eliminating pads appropriate for each pump.

Provide rate of flow measuring meter with bypass arrangement with every set of pumps.

All water supply pumps shall be provided with mechanical seals.
Hydro Pneumatic System (Domestic & Flushing Water Supply Pumps)

Domestic water supply pumps shall be packaged type skid mounted hydro pneumatic system with fixed speed system. Complete system to be mounted on a common base frame.

Pumps shall be multistage, monoblock vertical centrifugal pumps with stainless steel body and stainless steel impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling. Each pump should operate a curve 10m below specified head.

Pressure vessel of non corrosive FRP composite construction lined with NSF and/or FDA listed material, like high density polyethylene with fully replaceable polyurethane. Air cell burst pressure of minimum of 5 times the vessel operating pressure and cycle tested for 2,50,000 cycles. No. and capacity of Pressure Vessel As per manufacturer recommendation.

Pump and motor shall be mounted on a common M.S. structural base plate or as required as per site conditions.

Each pump shall be provided with a totally enclosed fan cooled induction motor.

Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal “Burden” type pressure gauge with gunmetal isolation cock and connecting piping.

Provide vibration-eliminating pads appropriate for each pump.

Provide rate of flow measuring meter with bypass arrangement with every set of pumps.

All water supply pumps shall be provided with mechanical seals.

Pumps shall have Control Panel with programmable logic controller (PLC) for cyclic operation of pumps. Pump working sequence should change after every operation. Contractor overload relays and MCBs should confirm to IEC 898 – 1995/ specifications. Blinking indications for pumps start, trip, low level trip, and health supply should be provided in the panel along with the ammeter & voltmeter. Control panel should also consist of cooling fan.

SUMP PUMP

Sump pumps shall be submersible type for lifting domestic sewage or muddy water/drainage. Pump with impeller of approved material shall be mounted on waterproof motor. The impeller shall be suitable for handling solids upto 46-100mm dia.

The pump shall automatically operate with high water level and stop at low water level in the sump by means of “Electronic Level Controller”, of the approved make.

The sump pumps shall be complete in all respect and shall be installed as per manufacturer’s requirement as shown in the drawing. All accessories shall be In-Built as per manufacturer’s specification.

Sump pumps are compact monoblock dry motor submersible pumps for suitable rating, with non-clog free flow open impeller, minimum solid handling capacity up to 100mm for sewer & 40 for storm water. Suitable for operation on 415 volts + 5% -15%, 50 C/s A.C 3 phase supply, speed 960/1440R&M including oil chamber, guide wire for lifting & lowering of pump, M.S. galvanized lifting chain, duck foot bend.
The above pump sets must be supplied complete with following accessories:

- Complete piping 100mm dia common delivery upto 1.5m as shown in the drawing. (The pipe should be preferably heavy duty GI)
- Necessary valve i.e Butterfly valve on delivery/suction side and Non return valves are on delivery side.
- Necessary cable from pumps set to control panel.
- Electrical switch panel having all necessary accessories & safety devices of standard specifications. (Panels with sump pumps near each sump as per site conditions)
- Automatic built-up water level controller with necessary length of cable upto control panel.

**FIRE FIGHTING PUMPS**

**Electrical Operated Main Fire, Sprinkler and Jockey Pumps**

Pumping sets shall be single stage horizontal centrifugal single outlet with cast iron body and dynamically balanced bronze impellers. Connecting shaft shall be of stainless steel with bronze sleeve and grease-lubricated bearings.

Pumps shall be connected to the drive by means of spacer type love-joy coupling which shall be individually balanced dynamically and statically.

The coupling joining the prime mover with the pump shall be provided with a sheet metal guard.

Pumps shall be provided with approved type of mechanical seals.

Pumps shall be capable of delivering not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

The System shall meet the requirements of the National building Code 2005 (NBC).

Necessary ‘Y’ strainer on the suction side and pressure gauge with GM cocks on the delivery side including bypass arrangement (with 50 valve and up to 5M G.I. Medium pipes) for periodical testing of the working of the pumping set shall be provided.

Pump shall be mounted on common base frame fabricated from MS channel as per manufacturer’s specification.

Suitable RCC Pump-foundations as per manufacturer’s design and 4 nos. Dunlop (cushy foot) heavy duty Ant vibration mounting pads shall be provided.

**Motors for Electric Driven Pumps**

Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors.

Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33°C ambient temperature. Motors shall conform to I.S: 325.

Motors shall be designed for two start system.

Motors shall be capable of handling the required starting torque of the pumps.

Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

**Air Vessel for Fire Pumps**

Provide an air vessel fabricated from 10mm M.S. sheet with dished ends and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 25mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. The vessel shall be 450mm in dia and 2000 mm high and tested to 10.0Kg/cm2 pressure.

The fire pumps shall operate on drop of 1 Kg/cm2 pressure in the mains. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

**Operating Conditions for the Service Pumps**

<table>
<thead>
<tr>
<th>Fire Pump</th>
<th>Nos.</th>
<th>Cut in Pressure</th>
<th>Cut Out Pressure</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jockey pump</td>
<td>One</td>
<td>8.2 kg/cm²</td>
<td>6.7 kg/cm²</td>
<td>To auto start and auto stop on pressure switch on air vessel.</td>
</tr>
<tr>
<td>Main pump</td>
<td>One</td>
<td>6.2 kg/cm²</td>
<td>Push button manual</td>
<td>To auto start on pressure switch on air vessel and manual off.</td>
</tr>
<tr>
<td>Diesel Fire Pump</td>
<td>One</td>
<td>5.7 kg/cm²</td>
<td>Push button manual</td>
<td>To auto start on pressure switch on air vessel and manual off.</td>
</tr>
<tr>
<td>Sprinkler Pump</td>
<td>One</td>
<td>6.7 kg/cm²</td>
<td>Push button manual</td>
<td>To auto start on pressure switch on air vessel and manual off.</td>
</tr>
</tbody>
</table>

**Diesel Fire Pump**

**Scope**

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

**General**

The diesel pump set shall be suitable for automatic operation, complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

**Drive**
The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1450/1800 rpm.

**Fire Pump**

The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2280 lpm as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg. per cm² at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 8 Kg. per cm² in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the Rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

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.

Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

**Diesel Engine**

**Environmental Conditions** - The engine shall be required to operate under the conditions of environment as required as per site conditions.

**Engine Rating** - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to B.S: 649/I.S: 1601/I.S: 10002, all amended up to date.

**Engine Accessories** - The engine shall be complete with the following accessories:-

- Fly sheet dynamically balanced.
- Direct coupling for pump and Coupling Guard.
- Radiator with hoses, fan, water pump, drive arrangement and guard.
- Corrosion Resister
- Air cleaner, oil bath type/dry type
- Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- Pump for lubricating oil and lub. oil filter
- Elect. starting battery (2x12 v)
- Exhaust silencer with necessary pipe work
- Governor
• Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual staring).
• Necessary safety controls
• Winterization arrangement, where specified.

**Cooling System** - The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

**Fuel System** - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on brackets at a height not less than 60 cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine.

A semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of work.

**Lubricating Oil System** - Forced feed lub. oil system shall be employed for positive lubrication. Necessary lub. oil filters shall be provided, located suitably for convenient servicing.

**Starting System** - The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The battery capacity shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

**Exhaust System** - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 5 meter from the engine manifold. (Adjustment rates for extra length shall also be given). The total back pressure shall not exceed the engine manufacturer’s recommendation. The exhaust piping shall be suitably lagged.

**Engine Shut Down Mechanism** - This shall be manually operated and shall return automatically to the starting position after use.
Governing System - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

Engine Instrumentation - Engine instrumentation shall include the following:

- Lubricant oil pressure gauge.
- Lubricant oil temperature gauge.
- Water pressure gauge.
- Water temperature gauge.
- Tachometer.
- Hour meter.

The instrumentation panel shall be suitably resilient mounted on the engine.

Engine Protection Devices - Following engine protection and automatic shut down facilities shall be provided:

- Low lub. oil pressure
- High cooling water temp.
- High lub. oil temperature
- Over speed shut down.

Pipe Work - All pipe line with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems. Copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

Anti Vibration Mounting - Suitable vibration mounting duly approved by Engineer-in-Charge shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Battery Charger - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

CABLES

Contractor shall provide all power control cables from the motor control center to various motors, level controllers and other control devices.

Cables shall conform to I.S: 1554 and carry ISI mark.

Wiring cables shall conform to I.S 694.

All power and wiring cables shall be aluminum conductor PVC insulated armored and PVC sheathed of 1100 volts grade.

All control cables shall be copper conductor PVC insulated armored and PVC sheathed 1100 Volt grade.

All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer’s name.
All cable joints shall be made in approved manner as per standard practice.

CABLE TRAYS

Contractor shall provide M.S slotted cable trays at locations as shown on the drawings.

Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by anchor fasteners.

EARTHING

There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armor clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.

Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centers. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.

A brick masonry manhole 30x30x30cm 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.

CONTROL PANELS / STARTERS

Switch board cubicles of approved type shall be fabricated from 16-gauge M.S. sheet with dust and vermin proof construction. It shall be painted with powder-coated finish of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the followings:

- Incoming main isolation MCCB of required capacity.
- Fully Aluminum taped Bus Bar of required capacity.
- Isolation MCCB one for each motor.
- Fully automatic as specified D.O.L/Star Delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps. (DOL up to 7.5 HP and Star Delta from more than 7.5 H.P)
- Single phase preventer of appropriate rating for each motor.
- Panel type ampere meters one for each motor with selector switch.
- Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.
- Neon phase indicating lamps for incoming main and on/off indicating lamps for each motor.
- Rotary switch for manual or auto operation for each pump (manual/auto off).
- Fully taped separate aluminum bus bars of required capacity and with required outlets.
- Space for liquid level controllers as specified + 1 extra space.
- The panel shall be pre-wired with color-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
- Provision of main incoming cables from the top of the panel.

All switch gears and accessories shall be of approved make such as “Siemens, Larsen & Toubro” or equivalent.

Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers. All floor-mounted switchboards shall rest on minimum 225mm high platform. The contractor shall provide the shop drawings for base and panels.

**VIBRATION ELIMINATORS**

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer’s details.

**ILLUMINATED FACSIMILE ANNUNCIATOR PANEL**

**Scope**

Scope of this section comprises the supply, installation, testing and commissioning of illuminated facsimile annunciation panel.

**Illuminated Facsimile Enunciator**

Illuminated facsimile enunciator shall be provided with facsimile of the building, constructed of acrylic panels of suitable dimensions, showing the Basement, Ground floor plans and section showing the location of Zonal Panels on each typical floor, entry points, various facilities shown with enamels in various colors.

Alarm lights to indicate fire location shall be arranged within the acrylic panel and shall be either automatically lighted by operation of any automatic fire detection devices or manual station, or by control of push button incorporated in the control desk.

Indicator of each building or facility shall include two lamps connected in parallel and so arranged that the failure of either of the lamps is readily apparent when a call or test is made.

Power for the Enunciator shall be supplied from the power supply for the control desk.

Representation of the various plans/Drawings on the acrylic of the Enunciator shall be by negative film processing with colored Discrimination of various zones for which the drawings shall be furnished for approval.

**WATER FILTER**

Water filter shall be of dual filter media pressure filter downward or upward flow type suitable for a rate of filtration.
Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure as given below. The minimum thickness of shell will be 8mm and dished ends shall be 10mm. The filter shall have at least one pressure tight manhole cover.

Filter shall be provided with screwed or flanged connections for inlet, outlet, individual drain connections and all other connections necessary and required. Filter shall be painted inside with two or more coats of non-toxic corrosion resistant paint, one coat of red oxide primer outside with two or more coats of synthetic enamel paint of approved shade.

**Under Drain System**

Filter shall be provided with an efficient under drain system comprising of collecting pipes, gunmetal/polypropylene nozzles of manufacturer’s design. The entire under drain system be provided on M.S. plate or cement concrete supports.

**Face Piping**

Filter shall be provided with interconnecting face piping comprising of inlet, outlet, and backwash pipe complete with pipes, valves and accessories, as per requirement. Piping shall be G.I/M.S. piping, medium duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves on SOUNDERS pattern with C.I. body and Neoprene rubber diaphragm.

**Accessories**

Each filter shall be provided with following accessories:

- Air release valve with connecting piping.
- 150mm dia dial burden type gunmetal pressure gauges with gunmetal isolation cock and connecting piping on inlet and outlet.
- Sampling cocks on raw water inlet and filtered water outlet.
- Individual drain connection with gunmetal full way valve.
- Connection with valve for air scouring.

**WATER SOFTENER**

Softener shall be designed to give zero commercial hardness. Softener shall be with cation exchange resins.

Softener vessel shall be of mild steel plate with dished ends and self supporting arrangement. Vessel shall be suitable for a working pressure. The shell shall have a minimum thickness of 8mm and dished ends 10mm. The vessel shall be painted internally with non-toxic bitumen paint and externally with one coat of red oxide and two or more coats of synthetic paint to give an even shade.

The vessel shall have an internal collecting and distribution system of manufacturer’s design.

The softener shall have a set of interconnecting face piping consisting of inlet, outlet and brine injection system with valves and accessories complete as per requirement. Piping shall be M.S. medium duty, as per I.S: 1239 and valves shall be cast iron double flanged sluice valves on SOUNDERS pattern, with C.I. body and Neoprene rubber diaphragm (suggested make LABLINE, NKI or equivalent).

One set of hydraulic injector with control valve, brine delivery pipes with adjustable indicator.
One cylindrical salt saturator and measuring tank of M.S. rubber lined having a capacity of a minimum of two regenerations for.

One orifice board for indicating wash and rinse rate to be fitted in drain sump.

One charge of supporting gravel, sand and “cation” resin in requisite quantity. Resin shall be Indian 220 or approved equivalent make.

One water testing kit with instructions for testing water samples.

**PIPING**

Pipes for suction and delivery shall be galvanized/M.S tube (heavy duty) confirming to I.S:1239 up to 150mm dia and as per I.S:3589 for dia 200mm and above. The M.S flanges shall confirm to I.S:6392-1971.

Gate valve and check valve above 65mm dia shall be C.I. double flanged conforming to I.S:780 manufactured by the reputed manufacturers or C.I. double flanged butterfly valves.

Full way and check valves 65mm dia and below shall be gunmetal tested to 20Kg/cm² pressure certified and conforming to I.S:778.

Suction strainer or foot valves shall be C.I., confirming to I.S:4038 - 1979.

**Joints**

All pipes and fittings shall be provided with flanged joints, with flanges either screwed or welded complete and jointed with 1.5mm thick gasket complete with nuts, bolts and washers etc.

**Testing**

All G.I pipes (except fire pipe) shall be tested hydrostatically for a period of 30 minutes to a pressure of 7 Kg/cm² without drop in pressure and all G.I pipes for fire shall be tested hydrostatically for a period of 30 minutes to a pressure of 10 Kg/cm² without drop in pressure.

**GUARANTEE**

The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

The form of warranty shall be as approved by the Engineer-in-Charge.

The warranty shall be valid for a period of one year from the date of commissioning and handing over.

The warranty shall expressy include replacement of all defective or under capacity equipment, Engineer-in-Charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-Charge.

**IMPORTANT INSTRUCTION FOR QUALITY OF WATER**
The successful contractor will have to carry out a test of raw water from all the sources of water for the Hospital at their own cost from a reputed lab as approved by the Engineer-in-Charge / Consultant. On the basis of these results the contractor has to submit his shop drawings, design calculations and specifications accordingly.

Please note that it is ultimately the responsibility of the contractor to provide treated water for different use in the hospital as per International Standard as given in the attached guidelines.

**REQUIRED QUALITY OF TREATED WATER**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Characteristics</th>
<th>Acceptable as per Indian Standard of P.H.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turbidity (Units on J.T.U scale)</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>Colour (Units on Platinum Cobalt scale)</td>
<td>5.0</td>
</tr>
<tr>
<td>3</td>
<td>Taste and Odour</td>
<td>Unobjectionable</td>
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<tr>
<td>4</td>
<td>pH</td>
<td>7.0 to 8.5</td>
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<tr>
<td>5</td>
<td>Total dissolved solids (mg/l)</td>
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<tr>
<td>6</td>
<td>Total hardness (mg/l) (as CaCO3)</td>
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<tr>
<td>7</td>
<td>Chlorides (as Cl) (mg/l)</td>
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<tr>
<td>8</td>
<td>Sulphates (as SO4)</td>
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<td>9</td>
<td>Fluorides (as F) (mg/l)</td>
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<td>Nitrates (as NO3) (mg/l)</td>
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<td>Zinc (as Zn) (mg/l)</td>
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<td>Anionic detergents (mg/l) (as MBAS)</td>
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<td>Mineral Oil (mg/l)</td>
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<td>20</td>
<td>Arsenic (as As) (mg/l)</td>
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<tr>
<td>Sl. No.</td>
<td>Characteristics</td>
<td>Acceptable as per Indian Standard of P.H.E.</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------------------</td>
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<tr>
<td>21</td>
<td>Cadmium (as Cd) (mg/l)</td>
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<tr>
<td>22</td>
<td>Chromium (as hexavalent Cr) (mg/l)</td>
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<tr>
<td>23</td>
<td>Cyanides (as CN) (mg/l)</td>
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<tr>
<td>24</td>
<td>Lead (as Pb) (mg/l)</td>
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<td>25</td>
<td>Selenium (as Se) (mg/l)</td>
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<td>26</td>
<td>Mercury (total as Hg) (mg/l)</td>
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<td>Polynuclear Aromatic Hydrocarbons (PAH)</td>
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<td>28</td>
<td>Gross Alpha activity</td>
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<tr>
<td></td>
<td>Gross Beta activity Pci = pico curie</td>
<td>30p Ci/l</td>
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<td>29</td>
<td>Bacteriological Quality of piped water supplies</td>
<td>Treated water entering the distribution system</td>
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<td>29.1</td>
<td>Faecal coliforms number/100 ml</td>
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<tr>
<td>29.2</td>
<td>Coliform organisms number/ 100 ml</td>
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</table>
ELECTRICAL WORK
SUBJECT: Proposed Electrical Work for Medical College & Hospital at Sundergarh, Odisha.


a) Supply of D.G. Set
b) Installation of D.G. Set.
c) Bus Duct / Cabling
d) D.G. Set Aux. Panel.
e) Earthing System.
f) D.G. Set Exhaust Piping
g) Safety Equipment
h) SIT&C of 33KV/0.415KV Substation
i) Synchronizing Panels
j) Main L.T. Panels
k) Bus Duct
l) Floor Distribution Panel
m) Distribution Boards
n) Main & Sub main Cables
o) Point Wiring
p) Light Fixtures
q) Telephone System
r) Data cabling Network
s) Addressable Fire Detection System
t) Public Address System
u) CCTV System
v) Lightning Protection System
w) UPS System
x) Access Control System
y) External Lighting
z) All other item as detailed in Schedule of Quantities.
INTRODUCTION
A centralised electrical system shall be designed, installed & commissioned to provide the electrical power for Medical College & Hospital at Sundergarh, Odisha.

OUTSIDE DESIGN CONDITION

<table>
<thead>
<tr>
<th>Minimum Temperature</th>
<th>Maximum Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5 °C</td>
<td>50 °C</td>
</tr>
</tbody>
</table>

LOCATION OF D.G. SET & SUBSTATION:
D.G. Set shall be installed on Ground Floor Level as per drawing attached.

CAPACITY OF D.G. SET:
2x1000 KVA + 1x600 KVA, 415 Volt radiator cooled D.G. Set with acoustic enclosure shall be installed on Ground Floor Level to provide the power backup as per requirement in case of power cut / break down of Grid Supply.

CAPACITY OF 33KV / 0.415KV SUBSTATION:
3x1750 KVA, 33KV/0.415KV, 3 Phase, 4 Wire, 50 Hz, Oil type transformer with on load tap changer shall be installed on Ground Floor Level to provide the power to entire complex with required H.T. Panel etc.

STARTING METHOD FOR D.G. SET:
D.G. set shall be suitable for Manual/Auto start through D.G. Set Controller and shall be compatible for synchronizing through Synchronizing relay.

D.G. COOLING METHOD:
D.G. Set shall be radiator cooled.

EARTHING SYSTEM:
The earthing system to be provided for the D.G. set system as required as per IS: 3048.

D.G. SYNCHRONIZING PANEL:
D.G. Synchronizing Panel shall be installed in D.G. Room for synchronization of D.G. Sets.

Main L.T. PANEL:
Main L.T. Panel to be installed in D.G. Room for changeover the power and power distribution for entire building.

CAPACITOR PANEL:
Capacitor Panel to be installed to improve the power factor as per norms of SEB.
TECHNICAL SPECIFICATION OF EQUIPMENTS
D.G. SET

INTENT OF SPECIFICATION:

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

CODES AND STANDARDS:

The equipment furnish under this specification shall conform to the following latest standard, except where modified or supplemented by this specification:

- BS:5514: Specification for reciprocating internal combustion engine.
- BS:5000: Rotating electrical machines of particular type or for particular applications.
- IS:1239 (Part - I&II): Mild steel tubes and fittings.
- IS:1651: Stationary cells and batteries lead acid type (with tubular positive plates).
- IS:4540: Mono-crystalline semi-conductor rectifier assemblies and equipment.
- IS:5: Colours for ready mixed paints.
- IS:4722: Rotating electrical machines
- IS:10000: Methods of tests for internal combustion engines.
- IS:10002: Specifications for performance requirements for constant speed compression ignition (Diesel) engine for general purposes (above 20 KW).
- IS:2147: Degree of protection provided by enclosure for low voltage switchgear and control gear.
- IS:1600: Code for type testing of constant speed IC engines for general purposes.
- IS:1601: Performance of constant speed IC engines for general purposes.
- ASME Power Test Code PTC-17: Internal combustion engines.

ENGINE:

Diesel Engine shall be stationary, compression, ignition, totally enclosed, water cooled, stroke cycle, cold battery starting, turbo charged and after cooled heat exchanger cooled 1500 RPM in accordance to BS and IS specification complete with all accessories.

COOLING SYSTEM:
Cooling system shall be radiator cooled.

**FUEL SYSTEM:**

Fuel System shall have PT Fuel Pump, Injectors, Fuel filters, Self contained piping & houses, Complete piping.

**LUBRICATING SYSTEM:**

Lubricating system shall have Oil pump, Strainer, Lube oil cooler, Oil filter, Bypass filter, Self contained piping, Lube oil priming pump.

**AIR INTAKE SYSTEM:**

Air intake system shall have dry type filter, Air intake manifold with necessary connections, Turbocharger with after cooler.

**EXHAUST SYSTEM:**

Exhaust system shall have Exhaust Manifold, Flexible piping, Hospital silencer to limit the noise level and extending silencer outside the canopy.

**STARTING SYSTEM:**

Starting system shall have Starter 24V with suitable ampere capacity, Charging Alternator with inbuilt regulator 24 V minimum 30 AMP DC or as per battery capacity, Connecting links between battery & alternator. The engine shall be suitable for black start.

**MAIN AND BIG END BEARING:**

The main and big end bearing shall be detachable shells of high grade bearing material, and shall be pre finished. The dimensions of big end bearings shall be such that the connecting rods can be withdrawn through the cylinder liners.

**COUPLING ARRANGEMENT:**

Coupling arrangement shall have Flexible coupling, Flywheel, Flywheel Housing, Coupling Guard

**INSTRUMENT PANEL:**

Instrument Panel shall have-
- Lube oil pressure gauge
- Water temperature gauge
- RMP Indicator & Hour Meter.
- Battery charger ammeter.
- Starting switch with key

**SAFETY CONTROL TRIP:**

- Low Lube oil pressure
- High Water temperature
- Engine over speed.
- Lub oil temperature.

**ALTERNATOR:**
Output : 1010 KVA / 600 KVA self excited, self regulated foot mounted fitted with ball and roller bearings and having PMG, droop CT for paralleling. This shall give full output of 1010KVA / 600 KVA at 40 deg. C.

Power factor : 0.8

Rated Generating Voltage : 415 Volts, 3 phase 4 wire system

Voltage regulation : +/- 1.0% all load between no load to full load & power factor 0.8 to unity. AVR shall be mounted in alternator.

Frequency : 50 HZ

Speed : 1500 RPM

Overload Capacity : 10% for one hour in any 12 hours of operation without exceeding temperature rise limits specified in BS: 2613 when corrected to ambient temperature at site

Class of Insulation : H and temperature rise limited to class H

Space Heater : To be provided

Winding connection : Star connection (all six leads will be brought out of stator frame).

Termination : Termination box shall be amended to connect the bus duct.

The alternator shall be self-excited, self regulated, self ventilated in brush less for suitable automatic voltage regulator and shall conform to BS: 2613 or equivalent standard and shall give rated output at NTP conditions. The alternator shall have space heater which shall be connected with breaker NO/NC contacts and this should be able to cut off with thermostat.

OTHER ACCESSORIES:

FUEL TANK:

Day service fuel tank shall be made of 3mm thick MS sheet of 990 litres capacity for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, trough to collect split oil, air vent pipe with air filter, manhole with cover, low level and full level float valve arrangements with all fittings interconnections between tanks. The tank shall be provided with suitable calibration scale.

BASE FRAME:

M.S. Fabricated adequately machined base frame complete with lifting, facilities pre-drilled foundation holes suitable for permanent installation on foundation shall also be supplied. The base frame shall be manufactured with steel and shall be stress relieved. Manufacturer shall specify what measures are taken to reduce the stresses.

BATTERIES

For electrical control ckt of 24V D.C. of suitable ampere hour complete with battery charger, leads and wooden base plate and shall be placed inside canopy.

FUEL SYSTEM:
The engine shall be capable of running on High Speed Diesel fuel oil. The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid. A fuel service buffer tank, common for two DG set with 990 litres capacity shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. Service tank level switches (2 Nos. per tank) for alarm & trip shall also be provided by the bidder. All pipe joints should be brazed/welded. A hand pump for pumping the fuel into the fuel service tank together with necessary pipes or tubing shall be provided.

**SILENCER:**

Exhaust silencer shall be residential type to reduce the noise level.

**COOLING:**

The diesel engine shall be radiator cooled.

**ENGINE GOVERNER:**

The governor shall be Electronic type suitable for class A-1. This shall control the generator frequency, and shall be suitable for operation as per the selected battery voltage (24 V DC). The governor shall be provided with a manually adjustable over speed trip mechanism to automatically shut-off the engine or the fuel supply if the set reached 120 % of rated speed. Governor shall be capable to maintain zero speed rate or regulation and shall be Al type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit.

**TURBO CHARGER:**

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

**STARTER BATTERY:**

The battery shall conform to the requirement of IS: 1651. Starting battery sets of 24 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery shall be capable of performing at least (6) six normal starts without recharging.

The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

**ENGINE SAFEGAURD:**

Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:

- Energising a solenoid coupled to the stop lever on the fuel injection pump rack.
- De-energising the “fuel on” solenoid
- Energising the “fuel - cut off” solenoid.
- If any of the door opens.
The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.

The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.

At the set at a easily accessible place an “EMERGENCY STOP” mushroom head stay put type P.B shall provided to stop the set in emergency mode.

The safe guard to “STOP THE SET” shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

Emergency stop P.B’s operation
- Over speed.
- Low lube oil pressure.

SOUND ATTENUATING ACOUSTIC ENCLOSURE:

Sound Attenuating Acoustic Enclosure should have pleasant and aesthetical looks and should be able to bring down the noise to 72 decibels when measured at a distance of 1 meter away from the set.

The DG set should be supported on a base frame in an MS Sheet enclosure with suitable ducting for air inlet and outlet. The door and enclosure should be given corrosion resistant treatment and painted to be weatherproof and long lasting. Resin bonded Glass / Mineral / Rock wool of high density (greater than 45 Kg / Cu. M) with minimum thickness of 75 mm covered with perforated MS Sheet should be provided and covered with tissue paper. Enclosures should be provided with durable locking system with doors duly gasketed with neoprene rubber.

Exhaust gases should be taken out from the DG Set by means of MS Pipe and a noise suppressor.

Proper care should be taken for engine heat rejection in order to have safe working temperature inside the enclosure by provision of fans etc, as required. The design aspect should ensure free and uninterrupted flow of suction and exhaust air in order that the temperature rise of the enclosure with respect to the ambient is less than 7°C.

Radiator hot air shall be throughout on top instead of front. The arrangement to be made accordingly in acoustic enclosure.

ERECTION, TESTING & COMMISSIONING OF D.G. SETS:

ERECTION, TESTING, COMMISSIONING AND PERFORMANCE OF DG TESTS:

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Owner along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the contractor.

The successful contractor shall submit sufficiently in advance the bio-data of the supervisor giving details of his experience for Owner’s approval.

The contractor shall ensure that the equipment supplied by him are installed in a neat workman like manner such that they are leveled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Owner.
All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the contractor. The bid shall include a list of these special tools, tackles and spares along with their item wise prices. The total cost for these tools, tackles and spares shall be included in the bid price.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

**COMMISSIONING CHECK TESTS / PERFORMANCE AND GUARANTEE TEST:**

In addition to the checks and test recommended by the manufacturer, the contractor shall supervise the following acceptance tests to be carried out on each test.

**LOAD TEST:**

The engine shall be given test run for a period of at least 6 hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.

This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator and exciter shall be satisfactory at the end of this overload run.

At the end of the full-load run, and again at the end of the over-load run, tests for temperature rise and insulation resistance of the alternator as specified shall be taken.

Full load test can be performed at site or at manufacturer’s works before dispatch and shall be monitored by the Client/Consultants/Representative.

During the load test half hourly records of the following shall be taken:

- Ambient temperature
- Exhaust temp when exhaust thermometer is fitted.
- Cooling water temp at a convenient point adjacent to the water output from the engine jacket.
- Lubricating oil temperature when an oil cooler is fitted.
- Lubricating oil pressure.
- Speed
- Voltage, wattage and current output.
- Oil tank level
- Colour of exhaust gas
- Stored diesel oil temperature

**INSULATION RESISTANCE TEST FOR ALTERNATOR:**

Insulation resistance in mega-ohms between the coils and the frame of the alternator when tested with a 500 Volts megger shall not be less than

\[ IR = 2 \times (\text{rated voltage in KV}) + 1 \]

**REGULATION TEST:**

The automatic and manual regulation of the alternator load at half and full rated load shall be tested for a nominal volts of 240 Volts, between phase to neutral and at 0.8 p. f. to verify the requirements of voltage and frequency variation as per IS:4722.
SPEED AND GOVERNING:
The speed of the engine shall be verified to ensure that it conforms to the requirement of BS:5514.

VIBRATION:
The vibrations shall be measured during full load test as well as during the overload test and the limit shall be as per IS.

CHECK FOR FUEL CONSUMPTION:
A check of the fuel consumption shall be made through out the test run of full load and overload. The D.G. Set shall generate 4 unit / litre under 40% to 100% load condition.

NOISE LEVEL:
The equivalent ‘A’ weighted sound level measured at a distance of 1 meter horizontally from the base of any equipment furnished and installed under these specifications expressed in decibels to a reference of 0.0002 microbar, shall not exceed 75 DB.

SPARE PARTS FOR DG SETS:
MANDATORY SPARE PARTS:
The list of mandatory spares to be submitted by the contractor to owner along with bid.

CABLE WORK

DESCRIPTION OF WORK
Supply, laying, testing and commissioning of cables as per specifications, schedule of quantities and drawings.

APPLICABLE CODES & STANDARDS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>IS: 10242 (Part-3, Section-12)</td>
<td>Installation of cables for low voltage System</td>
</tr>
<tr>
<td>IS: 7098 (Part-1&amp;2)/IS: 5831/</td>
<td></td>
</tr>
<tr>
<td>IEC: 60502/BS: 6746/BS:5467</td>
<td>Cross linked polyethylene insulated PVC sheathed cables.</td>
</tr>
<tr>
<td>Part-I</td>
<td>For working voltages up to &amp; including 1100 Volts.</td>
</tr>
<tr>
<td>Part-II:</td>
<td>For working voltage from 3.3 KV up to &amp; including 33 KV.</td>
</tr>
<tr>
<td>IS: 10810</td>
<td>Method of test for cables</td>
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</table>
CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGARH, ORISSA

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS: 1255</td>
<td>Code of practice for installation &amp; maintenance of power cables up to &amp; including 33 KV rating.</td>
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<tr>
<td>IS: 8130/IEC: 60228</td>
<td>Conductors for cables</td>
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<tr>
<td>IS: 10418</td>
<td>Drums for electric cables.</td>
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<tr>
<td>IS: 2062, IS: 800, IS: 816</td>
<td>Structural wedding steel</td>
</tr>
</tbody>
</table>

SUBMITTALS
Cable schedule as per site conditions & good for construction drawings.

Layout of various cables on cable tray / trench along with sections showing no. of cables, distance between cables etc, size of cable trays etc.

Cable tray layout, as per site condition, duly coordinated with other services.

TEST REPORTS
Routine test certificates for each drum of cable brought to site.

SPECIFICATIONS
GENERAL
Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

MATERIAL
The MV power cable of 1100 V. grade shall be FRLS Aluminium conductor armoured cable as per relevant IS.

The MV control cables shall be PVC insulated copper conductor armoured cable.

The HT power cable of 33 KV grade shall be XLPE insulated Aluminium conductor armoured cable.

INSTALLATION
GENERAL
The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S. 1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Engineer-in-Charge.

PROXIMITY TO COMUNICATION CABLES
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 30 cm.

CABLE LAYING DIRECT IN GROUND
GENERAL

This method shall be adopted where the cable route is through open country along roads/lanes etc. and where no frequent excavation are encountered and where excavation is easily possible without affecting other services.

TRENCHING

WIDTH OF TRENCH: - The width of trench shall be determined on the following basis:

a) The minimum width of trench for laying single cable shall be 35 cm.

b) 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 inter-axial spacing between the cables, except where otherwise specified shall be at least 20 cm.

c) There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

DEPTH OF TRENCH:- The depth of trench shall be determined on the following basis:

a) Where cables are laid in single tier formation, the total depth of trench shall not be less than 75 cm. for cables up to 1.1 KV and 1.20 m for cables above 33 KV.

b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in (i) above shall be increased by 30 cm. for each additional tier to be formed.

EXCAVATION OF TRENCHES

a) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided complying with the requirements.

b) Where gradients and changes in depth are unavoidable, these shall be gradual.

c) Excavation shall be done by any suitable means-manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

d) Adequate precautions shall be taken not to damage any existing cables, pipes or other such installations in the proposed route during excavation. Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried without the approval of the Engineer-in-Charge.

e) Existing property exposed during trenching shall be temporarily supported or propped adequately as directed by the Engineer in charge. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein and the trench refilled.

f) If there is any danger of a trench collapsing and endangering adjacent structures, the sides should be well shored up with timbering and/or sheeting as the excavation proceeds. Where necessary, these may even be left in places when back filling the trench.

g) Excavation through lawns shall be done in consultation with the staff of the department/Owner concerned.

h) The bottom of the trench 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 8 cm. in depth.
LAYING OF CABLE IN TRENCH

a) At the time of issue of cable for laying, the cores shall be tested for continuity and insulation resistance.

b) The cable drum shall be properly mounted on jacks or on a cable wheel, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

c) The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be pulled of in one stretch. However, where this is not possible the remainder of the cable may be removed by 'Flaking' i.e. by making one long loop in the reverse direction.

d) i) After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.

   ii) For short runs and sizes up to 50 Sq. mm of cables up to 1.1 KV grade, any other suitable method of direct handling and laying can be adopted with the prior approval of the Engineer-in-Charge.

e) When the cable has been properly straightened, the cores shall be tested for continuity and insulation resistance. In case of PVC cables, suitable moisture seal tape shall be used for this purpose.

f) i) Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid.

   ii) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cm shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm. as stated above. The top most cable shall have a final sand covering not less than 17 cm. before the protective cover is laid.

g) At the time of original installation, approximately 3 m of surplus cable shall be left on each end the cable and on each side of underground joints (Straight through/Tee/Termination) and at entries and places as may be decided by the Engineer-in-Charge. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length loose cable may be left at suitable intervals as specified by the Engineer-in-Charge.

h) A final protection to cables shall be laid in accordance with Clause j to provide warning to future excavators of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc.

i) 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, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Engineer-in-Charge. 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 the end cables.
BACK FILLING

a) The trenches shall be back-filled with excavated earth free from stones 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 centre and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth however should not exceed 10 cm. so as not to be a hazard to vehicular traffic. The temporary re-instatement of roadways should be inspected at regular intervals, particularly during the wet weather, and any settlement should be made good. Further trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved in accordance with the relevant Specifications to the satisfaction of the Engineer-in-Charge.

a) Where road berm or lawns have been cut or kerb stones displaced, the same shall be repaired and made good except turfing/asphalting to the satisfaction of the Engineer-in-Charge and all surplus earth or rock removed to places as specified.

ROUTE MARKERS:

a) Route markers shall be provided along straight runs of the cables at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 100 m. Markers shall also be provided to identify change in the direction of the cable route and also for location of every underground joint.

b) Route markers shall be made out of 100 mm x 100 mm x 5 mm GI/Aluminium plate, welded or bolted on to 35 mm x 35 mm x 6 mm angle iron 60 cm. long. Such plate markers shall be mounted parallel to and 0.5 m or so away from the edge of the trench.

Alternatively cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) marker 60 cm x 60 cm 10 cm in size shall be laid flat and centred over the cable. The concrete markers unless otherwise instructed by the Engineer-in-Charge shall project over the surrounding surface so as to make the cable route easily identifiable.

c) The work ‘cable’ and other details such as voltage grading, size etc. as furnished by the Engineer-in-Charge shall be inscribed on the marker.

LAYING IN PIPES/CLOSED DUCTS:

In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the Civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embedded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. from the ground level when laid under roads, pavement etc.
Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of poly phase system.

The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

Manholes of adequate size as decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Engineer-in-Charge through another agency.

Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.

All chases and passages necessary for laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge.

Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

**LAYING ON CABLE TRAY**

Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.

The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, and structural steel members (comprising of channels, angles, flats, rods) for structural supports for cable trays etc.

**CABLE TRAY MOUNTING**

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following:

a) Cable tray mounting arrangement type to be as marked on layout drawing.

b) Assembly of tray mounting structure shall be supplied, fabricated, erected & painted by the contractor.

c) Cable tray running along the wall should be supported at intervals not exceeding 1.5 m. In case of branching, there should be a support on all branches at a distance of 30 cm from the point of branching. Support should not be less than 40 mm x 40 mm x 5 mm MS angle-secured in an approved manner where runs are along the walls. In case of ceiling suspended cable tray horizontal supports made of 40 mm x 40 mm 5 mm MS angle iron shall be provided. The horizontal interval between two such supports shall be 1.0 meter. These supports shall be suspended from C.I. boxes or suitable approved
suspension devices such as dash fastener of suitable sizes in the ceiling by means of 10 mm diameter GI threaded rods. All above mounting accessories form part of installation of cable trays.

TESTING & COMMISSIONING

INSPECTION

All cables shall be inspected upon receipt at site and checked by the Engineer-in-Charge for any damage during transit.

TESTING

i. All 650/1100 Volt grade cables before laying shall be tested with a 500 V megger or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/amour and insulation resistance between conductors.

ii. All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

COMPLETION PLAN AND COMPLETION CERTIFICATE

a) After completion of the work the Contractor shall draw completion plans to a suitable scale and shall submit to the Engineer-in-Charge. The completion plans shall, inter-alia, give the following details

i) Layout of cable work

ii) Length, size, type and grade of cables.

iii) Method of laying i.e. direct in ground, in pipes etc.

iv) Location of each joint with jointing method followed.

v) Route marker and joint maker with respect to permanent land marks available at site.

vi) Wherever the previously laid cable is cut and additional joints are introduced etc., the cable records shall suitably be amended.

TESTING OF CABLES

The cables shall be tested before and after laying. The Megger value in normal dry weather shall be 50 Mega ohm for 1.1 KV grade cable. This value shall be 100 Mega ohm for 11 KV grade cable.

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 aluminium strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws and washers, 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 C.I. plate marked with “DANGER 1.1 KV CABLE” with 0.6 meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

CABLE TRAY

All cables trays shall be made of M.S. sheet.

Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays. The bends, Tee joint, Cross joint for all sizes of cable tray shall be factory fabricated.

Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

PERFORATED CABLE TRAY

Standard dimensions of perforated cable trays shall be as follows:

1. Width : 100 mm to 1200 mm
2. Length : 2500 mm
3. Thickness : 1.6 mm up to 300 mm width and 2 mm 450 mm to 600 mm width and 3 mm from 901 mm to 1200 mm
4. Collar height : 50 mm up to 600 mm and 75 mm from 750 mm to 1200 mm

LADDER TYPE CABLE TRAY

Standard dimensions of ladder type cable trays shall be as follows:

<table>
<thead>
<tr>
<th>SIZE OF TRAY</th>
<th>SIZE OF MAIN CHANNEL</th>
<th>SIZE OF RUNG/SPACING BETWEEN RUNGS</th>
</tr>
</thead>
<tbody>
<tr>
<td>900mm to 1200mm</td>
<td>25 x 100 x 25 x 3mm</td>
<td>20 x 50 x 20 x 2 @ 200C/C</td>
</tr>
<tr>
<td>Up to 750mm</td>
<td>25 x 75 x 25 x 2mm</td>
<td>20 x 50 x 20 x 2 @ 200C/C</td>
</tr>
</tbody>
</table>
Sizes of angle for cable tray supports shall be minimum 40 x 40 x 5 mm up to 600mm & 50 x 50 x 5mm minimum as specified in the drawings/schedule of quantities for sizes above 600 mm. Hangers shall be of minimum 10 mm dia steel round bars up to 600 mm & 12 mm dia steel from 750 mm to 1200 mm as specified in the drawings/schedule of quantities. All the support shall be G.I.

Fixing arrangement shall be as approved by the Consultant.

Hardware to be used in cable tray system shall be galvanized or zinc passivated.

The testing on galvanized material if required shall be carried out as per IS: 2633, amended to date.

**RACEWAY**

All raceway shall be of 1.6mm/2.0mm thick G.P. sheet as specified in BOQ. The raceway shall have Z-section, hole with thread for cover screw, coupler plate, cover, junction box, fly cover etc as required. The screw for cover fixing shall be counter sunk type. The size of raceway shall be as follow.

<table>
<thead>
<tr>
<th>WIDTH (mm)</th>
<th>HEIGHT (mm)</th>
<th>THICKNESS (mm)</th>
<th>COVER THICKNESS (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>40</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>75</td>
<td>40</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>100</td>
<td>40</td>
<td>1.6</td>
<td>2.0</td>
</tr>
<tr>
<td>150</td>
<td>40</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>200</td>
<td>40</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>300</td>
<td>40</td>
<td>2.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**SAFETY MATERIALS**

**DESCRIPTION OF WORK**

A. Insulation Mats
B. First Aid charts and First Aid Box
C. Danger Plate
D. Fire Extinguishers
E. Fire Buckets
F. Tool Box
G. Caution Board
H. Key Board

APPLICABLE CODES & STANDARDS

A. IS : 15652 Insulation mats
B. IS : 2878 Portable CO2 Fire Extinguisher
C. IS : 2546 : Fire Buckets

SUBMITTALS

A. Product Catalogues.

SPECIFICATION

INSULATION MATS

A. Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

FIRST AID CHART AND FIRST AID BOX

A. Charts (one in English, one in Hindi, one in Regional Language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate places. Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in sub-station.

DANGER PLATE

A. Danger plates shall be provided on HV and LV equipments. LV danger notice plate shall be 200 mm x 200 mm made of mild steel atleast 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

B. Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick.

FIRE EXTINGUISHERS

A. Portable CO2 conforming to IS: 2878-1976 dry chemical (conforming to IS 2171-1976) extinguishers shall be installed in the sub-station at suitable places (like HT/LT panel rooms) as specified.

B. Foam type fire extinguisher shall be installed in Transformer Room.
FIRE BUCKETS

A. Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

TOOL BOX

A. A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

CAUTION BOARD

A. Necessary number of caution boards such as "Man on Line" "Don't switch on" etc. shall be available in the sub-station.

B. The Caution Board shall be of size 300 mm x 200mm made of mild steel, 2mm thick, vitreous enamelled white on both sides and with inscriptions in original red colour on front side as required.

KEY BOARD

A. A key board of required size shall be provided at a proper place containing castel keys, and all other keys of sub-station and allied areas.

B. The Key board shall be made of 12mm thick first class teak wood shall be of size 400 mm x 300m and with adequate depth to hold the keys. It shall be provided with a lockable type hinged glass door made of 12 mm. thick first class teakwood frame with 3 mm thick sheet glass fixed with piano hinges. The key board shall enough number of hooks for hanging the castle keys and all other keys of the sub-station and allied areas. It shall be painted with one coat of wood primer and two coats of white enamel paint.

PIPING WORK (D.G. FLUE GAS EXHAUST SYSTEM)

SCOPE OF WORK

The scope of this section comprises supply, installation, testing & commissioning of D.G. Flue Gas Exhaust System pipes & pipe fittings etc. as detailed below in specifications. All pipes and fittings etc. shall conform to relevant Indian standards.

D.G. FLUE GAS EXHAUST PIPING

D.G. Exhaust pipes shall be M.S. Black pipes up to 150 mm and MS ERW Black Pipes above 150 mm and it shall conform to IS:1239 (Part 1) -1991 & IS:3589 – 1991 Grade 330 with latest amendments.

All piping and their steel supports shall be thoroughly cleaned and primer coated before installation.

PIPE FITTINGS

The pipe fittings for screwed piping shall be malleable iron and for piping with welded joints shall of weldable quality. Also the fittings shall be suitable for same pressure ratings as for the piping system.

All bends up to sizes 150 mm dia shall be ready made of heavy duty wrought steel of appropriate class.

All bends in sizes 200 mm and above shall be fabricated from the same dia and thickness of pipe in at least four sections and having a center in radius of at least 1.5 times diameter of pipes. Fittings such as
tees, reducers etc. shall be fabricated from the same pipe and its length shall be at least twice the diameter of the pipe.

The dead ends shall be formed with flanged joints & shall have 6mm thick blank between flange pair for 150 mm and over.

**FLANGES**

All flanges shall be of mild steel as per IS : 6392 / 71 (with latest amendments) & shall be slip on type welded to the pipes. Flanged thickness shall be to suit Class II pressure.

Flanged pair shall be used on all such equipments which are required to be isolated or removed for service.

**PIPING INSTALLATION**

The drawings attached with this tender indicate schematically the sizes, location of pipes & vertical shafts. The contractor, on award of the work, shall prepare detailed shop drawings based on tender drawings, showing the cross-section, longitudinal sections, details of fittings and all pipe supports.

Piping shall be properly supported on, or suspended from, stands, clamps, springs, hangers as specified and as required at site. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and shall be responsible for their structural sufficiency. A set of piping support calculations shall be submitted for structural engineer review and approval before site installation wherever critical & required.

Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamps are of dissimilar materials, a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following:

<table>
<thead>
<tr>
<th>Pipe Sizes</th>
<th>Spacing Between Supports</th>
<th>Rod Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 12 mm</td>
<td>1.2 Meter</td>
<td>8 mm</td>
</tr>
<tr>
<td>15 to 25 mm</td>
<td>1.8 Meter</td>
<td>8 mm</td>
</tr>
<tr>
<td>32 to 150 mm</td>
<td>2.4 Meter</td>
<td>10 mm</td>
</tr>
<tr>
<td>Above 150 mm</td>
<td>--------------</td>
<td>As Per Approved Shop Drawing------</td>
</tr>
</tbody>
</table>

Vertical pipes passing through floors shall be plumb and parallel to wall. Pipes shall be supported on all floors. MS cleats shall be welded on pipes and rest on MS channel placed on the floor with 15 mm thick resistoflex pads between the cleat and channel. U clamps with resistoflex sheet shall be provided to keep the pipe in position.

T heading in exhaust piping shall be avoided.

Pipe sleeves at least 3 mm thick, 50 mm / 100 mm larger in diameter than exhaust pipes respectively shall be provided wherever pipes pass through retaining wall and slab. Annular space shall be filled with fibre.
glass and finished with retainer rings welded on the ends of the sleeve. All pipes passing through the retaining wall shall be provided with suitable water proofing compound.

Wherever pipes pass through the brick or masonry / slab openings, the gaps shall be sealed with fire sealant.

The Contractor shall make sure that the clamps, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required size in accordance with relevant BIS Codes, edges beveled and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.

PIPE INSULATION (D.G. FLUE GAS EXHAUST PIPING SYSTEM)

SCOPE OF WORK

The scope of this section comprises supply, installation, testing & commissioning of D.G. Flue Gas Exhaust Pipe Insulation and Aluminium Cladding as detailed in BOQ. All insulation material and aluminium cladding shall conform to relevant Indian standards.

H.T. METERING PANEL (INDOOR TYPE):

GENERAL

H.T. Metering Panel shall be made as per regulation of Local Electricity Supply Authority.

CODES AND STANDARDS

The 33 H.T. Metering Panel shall comply with the following standards as amended up to date.

- IS: 2544 : Bus Bar Supports
- IS: 2705 / IEC – 185 : Current Transformer
- IS: 3516 / IEC – 186 : Potential Transformer

SUBMITTALS

SHOP DRAWING AND TECHNICAL DATA

The Tenderer shall furnish relevant technical data on H.T. Metering Panel and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.
CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL SUNDARGRHAH, ORISSA

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

c) All drawings and data shall be in English.

TYPE AND CONSTRUCTION

The metal clad panel shall be made out of 2.0 mm thick CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer’s standard shade.

a. C.T. & P.T. Compartment
b. Energy Meter Compartment
c. Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. The H.T. Metering Panel shall be suitable for cable termination from bottom only. The Panel shall be supplied with all equipment mentioned in BOQ and as per regulation of Local Electricity Supply Authority.

33 KV VACUUM CIRCUIT BREAKER:

GENERAL

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB’s shall be suitable for operation on 33KV, 3 phase, 50Hz, AC supply.

CODES AND STANDARDS

The 33 KV VCB Panel shall comply with the following standards as amended up to date.

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS : 2516 (Part I – Set 3)</td>
<td>Indian Electricity Supply and regulations.</td>
</tr>
<tr>
<td>IEC 60298 &amp; IEC 60694</td>
<td></td>
</tr>
<tr>
<td>IS : 3427 &amp; IS 12729</td>
<td>Vacuum Circuit Breakers</td>
</tr>
<tr>
<td>IEC : 529</td>
<td>Degree of Protection – IP 55</td>
</tr>
<tr>
<td>IS : 2544</td>
<td>Bus Bar Supports</td>
</tr>
<tr>
<td>IS : 2705 / IEC – 185</td>
<td>Current Transformer</td>
</tr>
<tr>
<td>IS : 3516 / IEC – 186</td>
<td>Potential Transformer</td>
</tr>
</tbody>
</table>

RATING

The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 1000 MVA (18 KA RMS) at 33 KV. The rated making capacity shall be as per the relevant standards.
ACCESSORIES

Circuit Breakers shall be provided with the following accessories.

i. Auxiliary Switch with minimum 6 NO+ 6 NC auxiliary contacts.

ii. Shunt Trip Coil

iii. Mechanical Operation Counter

iv. Spring Charging motor and handle for manual charging

SUBMITTALS

SHOP DRAWING AND TECHNICAL DATA

The tenderer shall furnish relevant technical data on breakers and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams for control and supervision of circuit breakers.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) Type test certificates along with oscillograms for breakers of identical design.

e) All drawings and data shall be in English.

TYPE AND CONSTRUCTION

The metal clad panel shall be made out of CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer’s standard shade. The Switch Board Shall be fully extensible with following compartment.

a. Circuit Breaker Compartment

b. Bus bar Compartment

c. CT and Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be mounted on the top / bottom of
the panel at the front. The VCB shall consist of three air insulated poles incorporating mechanism of interrupters and suitable clearance between phases. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalized aluminium oxide. The contacts shall be of chromium copper and butt shaped. Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. The drawout carriage shall have two position for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy mono block designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

It shall be horizontal draw out & isolation type, fully interlocked, with dust and vermin proof construction, suitable for indoor installation. The panel shall be supplied with the manufacturer’s test certificates. Certificates with date of manufacture and shall be complete in all respects as per details given in the bill of quantities. The switchgear constructions shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

Total height of the H.T. Panel board shall be 2750mm approximately and width 1200mm (approx.). On the incoming breaker panel, a 100VA burden and Class I accuracy potential transformer 33KV/√3 /110V/√3 with LT fuses shall be provided. These shall be three single phase PTs cast resin insulated type. Adequate space at the rear of the panel shall be provided for termination of power & control cables. The panel shall be provided with suitable terminating arrangement for termination of cables. The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the bus bars & cable compartment for the fixed contacts. Safety shutters shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of bus bars side and cable side individually.

Mechanically operated circuit breaker auxiliary switches of minimum 6 NO + 6 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by using 1.5 sq. mm, 1.1KV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

L.T. Terminal blocks for control wiring shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 2.0KV for one minute. Bus bar compartment shall be provided at the rear. Electrolytic copper bus bars shall be of rectangular cross section and insulated. Bus bars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Bus bars shall be provided with necessary colour coding for phases indication. The bus bars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 50 deg. C. The standard clearance between phase bus bars to be maintained.

**BUS BAR AND INSULATORS**

Bus bars and connections shall be of high conductivity electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical
stresses due to specified short circuit currents. Bus bar cross section shall be uniform throughout the length of switch board. Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance. Bus bar insulators shall be of track-resistance, high strength, non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Bus bar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the bus bars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

EARTHING AND PROTECTIVE EARTHING

Copper earthing bus shall be provided. It shall be bolted/ welded to the frame work of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting Owner’s earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of bus bars & feeder circuit.

METERING AND PROTECTION

The VCB Panel Board shall be provided with cast resin current transformers for metering and protection. The CT’s shall conform in all respects to IS 2705-1964 Part-I, II and III. These shall have accuracy class of 1.0 for metering of 5P10 for protection. Potential transformers shall be epoxy cast resin type & conform to specifications of IS: 3156-1965 Part-I, II & III and shall be class-1. Electronic digital type Ammeter and voltmeter to be installed on panel. Electronic type digital energy analyser having parameter of KW, KWH power factor, frequency etc. with 30 days memory shall be provided. All meters shall be tested for 2000V for 1 minute and shall be 96mm square pattern, flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W). The electronic digital types IDMT relay (2 O/C + 1 E/F) to be provided as per B.O.Q. description.

INTERLOCKING, SAFETY AND OPERATING MECHANISM

Vacuum Circuit Breaker shall have electrically operated mechanism for spring charging. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty. The drawout carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is ‘On’. The circuit breaker cannot be switched ‘ON’ when the carriage is in any position between test & service position. The front door of the panel cannot be opened when the breaker is in service position or in an intermediate position. The low voltage plug & socket cannot be disconnected in any position except test/isolated position. The door cannot be closed unless the LV plug has been fitted. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed. Individual explosion vents shall be provided for breaker, bus bar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel. Circuit Breaker & sheet metal enclosure shall be fully earthed. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the drawout carriage mechanism.
ADDITIONAL ACCESSORIES

The loose items to be supplied with the 33KV VCB Panel Board shall comprise of the following:

b. Racking in/out handle.
c. Foundation bolts.
d. One number Earthing Trolley for cable side.

CONTROL SUPPLY

a. The tripping circuit shall be at 24 Volt D.C. through a power pack unit.

INSTALLATION

a. 33 KV switch board shall be installed and levelled on the foundation as per manufacturer's drawing. Bus bar connections shall be checked after installation. Cable end boxes shall be sealed after the cable work is completed to prevent absorption of moisture.

TESTS

FACTORY TESTS

The circuit breakers panel shall be subjected to routine tests at manufacturers works in accordance with the details specified in the relevant IS specifications.

The vendor shall submit the type test certificate for following along with the offer.

a. Temperature rise test.
b. Impulse & power frequency voltage test
c. Short time current test on circuit breaker.

SITE TEST

GENERAL

1. Verification for completion of equipment, physical damage/ deformities.
2. Alignment of panel, interconnection of bus bars & tightness of bolts & connection etc.
3. Interconnection of panel earth bus bar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.
6. Control wiring verification after interconnecting of panel.
7. Check for free movement of circuit breaker, lubrication of moving part & other Parts as per manufacturers manual.
9. Meggar before the Hi Pot test.

10. Meggar after the Hi Pot test.

11. CT/PT ratio/polarity primary injection test.

12. Secondary injection test on relays to practical characteristics.

These tests as per the clauses above will be witnessed by the owner/consultant at the works for which necessary information has to be given in advance to the owner/consultant.

### 33KV/0.415KV DISTRIBUTION TRANSFORMER

**GENERAL**

The transformer shall comply with the latest edition of the relevant Indian Standards / Manual. The transformer shall be copper double wound core type, oil natural air natural cooled suitable for indoor installation. The transformer shall be designed and manufactured as per IS – 2026 & 9815 with up to date amendments. Transformer shall be suitable for continuous rating as stated in BOQ and on drawings. The transformer winding shall be of electrolytic copper conductors covered with a special material having high tensile and dielectric strength. The Core shall be made up of high grade low loss cold rolled grain oriented steel sheets (CRGO). Core shall be treated with high temperature resistant paint to prevent corrosion at edges of the core plates. Distribution Transformer with on load tap changer, Balanced supply and unbalanced load.

**INPUT** : 33 KV, 3 Phase, 3 Wire, 50 Hz.

**OUTPUT** : 0.415 KV, 3 Phase, 4 Wire, 50 Hz.

**RATING** : 1750 KVA

**VECTOR GROUP** : Dyn-11

**OLTC** : +5.0% TO -15.0% IN STEP OF 1.25%

**AMBIENT TEMP** : -5 TO + 50 degree centigrade

**OIL TEMP RISE** : 40 deg. C. over a maximum ambient of 50 deg. C.

**WINDING TEMP RISE** : 50 deg. C. over a maximum ambient of 50 deg. C.

**WINDING TEMP** : Winding temp. indicator with NO/NC contact to be provided.

**OIL TEMP** : Oil temp. indicator with NO/NC contact to be provided.

**BUCHOLLZ RELAY** : Buchholz Relay with NO/NC contact to be provided.

**IMPEDANCE** : 6.25%
LOAD LOSSES : AS per ECBC 2007 (Revised)

TANKS & RADIATORS

Tanks shall be of MS. plates and structures, electrically welded. The construction shall be robust and substantial, suitable for road/rail transport and to withstand vibration. Radiator tubes shall be electrical resistance welded type, round or elliptical or rectangular. They may be welded to the transformer tank or in case of very large sizes to separate detachable radiator banks connected through intermediate leak proof valves. Detachable radiator banks shall have top and bottom headers with flanged connections, with drain and vent fittings. Tanks shall be provided with lifting lugs and jacking lugs. Inspection hole with cover should also be provided for large transformers. Oil conservators shall be mounted on brackets attached to the top cover on tank. Dimensions of the conservator shall be such as to allow change in volume of oil due to change in temperature from 0°C to 100°C.

Tanks shall be thoroughly cleaned, degreased and sand blasted inside and outside. A coat of rust resisting primer shall immediately be given on outside surface. Inside surface shall be painted with oil resistance enamel paint. Tank and radiators shall be hydraulically pressure tested. Tanks shall also be tested for full vacuum.

CORES

Cores shall be built from cold rolled grain oriented silicone steel laminations. The core laminations shall be insulated from each other by suitable high temperature resistant, oil proof, adherent coating materials. Core clamps and clamping bolts shall be heavily insulated from the core laminations.

The insulations of core bolt shall be minimum of class ‘A’. The bottom and top frames shall be connected with the tie rods to make a complete structure rigid for carrying the weight of core-coil assembly without unduly stressing the laminations or windings. Lifting eyes shall be provided on the frame for removal of core assembly from the tank. Completed core shall be flash tested for insulation with 2500 Volts between the core and each of the clamps or core bolts (core being connected to earth).

All the core frames shall be bonded together with two metallic strips and connected to the tank for earthing to ensure earth return and operation of protective gear in the event of a fault. Lifting eyes (or any other provision) for lifting the core from the tank shall be provided.

WINDING & INSULATION

Winding shall be three phase with minimum class ‘A’ insulation. High conductivity electrolytic quality copper shall be used for winding. Windings shall be suitably braced to withstand the dynamic forces due to short circuit. Winding insulation shall be uniform and windings shall have full insulation. Windings shall be individually vacuum dried before assembly as well as after assembly.

INSULATION OIL

Insulation oil shall conform to IS: 335. Transformers shall be supplied with initial fill of filtered oil.

GENERAL REQUIREMENTS

The transformer shall be outdoor type as specified. Unless otherwise specified the transformer in addition shall have thermal and dynamic ability to withstand external short circuit as per Clause 9 of IS: 2026 (Part I) 1977.
COOLING

Unless otherwise specified, the transformer shall be oil immersed natural air-cooled type (ONAN).

RTCC PANEL

RTCC Panel shall be microprocessor based Integrated RTCC Panel and shall be suitable for outdoor installation.

ACCESSORIES

The transformer shall be single tank type with 33 KV HV cable box as specified on HV side. LT side shall be suitable to receive the Bus Duct.

EXPLOSION VENT

Explosion vent or pressure relief device shall be provided of sufficient size for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank. Means shall be provided to prevent the ingress of moisture and gas accumulation.

RATING AND DIAGRAM PLATES

The following plates shall be fixed to transformer tank in a visible position.

a. A rating plate of weather proof material bearing the data specified in the appropriate clauses IS: 2026.

b. A diagram plate showing the internal connections and also the voltage vector relationship of the several windings in accordance with IS: 2026 and a plan view of the transformer giving the correct physical relationship of the terminals.

JOINTS AND GASKETS

All gaskets used for making cil tight joints shall be of proven material such as granulated cork bonded with synthetic rubber gaskets or synthetic rubber.

TESTS

The transformer shall be subjected to the following routine tests at the manufacturer's works before dispatch.

a) Measurement of winding resistance.
b) Voltage ratio, polarity and phase relationship.
c) Measurement of impedance voltage.
d) Load losses.
e) No load losses and no load current.
f) Induced over voltage withstand.
g) Separate source voltage withstand.
i) Vector group.
j) DV/DF Test.
k) Magnetic Balance Test.
l) High Voltage Test.
m) Insulation Resistance Test
n) All other test as specified in relevant IS Code.

The quoted rate for the transformer shall include all routine tests to be carried out at the manufacturer's works and all routine tests to be carried out at site as per specifications. The contractor shall quote separately for type tests, which shall be carried out only on the written instructions of Owner. The supplier shall give sufficient advance information about the test schedule to enable the owner to appoint his representative.

TESTING AT SITE

Prior to commissioning of the transformer the following tests shall be performed.

a) Insulation resistance of the winding between phases and earth of H.V and M.V. Side.
b) Voltage ratio test at principal tap, minimum tap & maximum tap position.
c) Magnetic Balance Test.
d) Performance/Settings of winding Temperature Indicator, Oil Temperature Indicator.
a) Insulation Resistance Test

CONTROL SUPPLY (SHALL BE PART OF H.T. PANEL)

a. The tripping circuit shall be at 24 Volt D.C. through a power pack unit.

MAIN L.T. PANEL-

GENERAL

This section covers the detail requirements for Design, Manufacturing, Testing at works. Main L.T. Panel shall be made out of CRCA sheet steel indoor type, floor mounted, free standing, totally enclosed, extensible type, air insulated type for use on 415 Volts, 3 phase with neutral, 50 cycles/sec system. D.G. Panel shall have PLC and required Hardware and Software (as per the BOQ) to achieve the AMF, Synchronizing and Interlocking.

The equipment shall be designed to conform to the requirements of:

i. IS: 8623- Factory Built Assemblies of switchgear and control gear.

ii IS: 4237- General requirements for switchgear and control gear for voltages not exceeding 1000 volts.
iii. IS: 2147- Degree of protection.
iv. IS: 375- Marking and arrangement of bus bar.

Individual equipment housed in the Main L.T. Panels shall conform to the following IS Specification.
i. Air circuit breakers/ moulded case circuit breaker IS: 60947 (Part-II) & IEC 60947 (2)
ii. Fuse switch and switch fuse units - IS: 13947 (Part-3) & IEC 947 (3).
iii. HRC fuse links - IS: 13703
v. Current Transformers - IS: 2705
Voltage Transformers - IS: 3156
vi. Indicating Instruments - IS: 1248
vii. Integrating Instruments - IS: 722
viii. Control Switches & Push Buttons - IS: 6875
ix. Auxiliary Contactors - IS: 13947 (Part-4/Sec.-1) & IEC 947 (4/1)
x. Relays - IS: 3231

SUBMITTALS, SHOP DRAWING AND TECHNICAL DATA

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams for control and supervision of circuit breakers.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

b) Type test certificates.

CONSTRUCTION

D. G. Panel shall be

1. Made out of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
2. The degree of protection being not less than IP 52 to IS: 2147.
3. Suitable for extensible on both sides by the addition of vertical sections after removal of the end covers.
4. Shall be suitable for cable entry from top / bottom both except wherever indicated through removable cable gland plate of 3 mm thick. Compression gland shall be staggered in alleys so as to maintain necessary clearance between cables.
5. Fire retardant polycarbonate sheet shall be provided for viewing panels housing MCB’s at eye level. Cable channels are to be used wherever possible for aesthetic look.

Lifting hooks / angles to be provided on the panel. Panel shall have 20% free space for future use.

Panel shall be provided with louvers having wire mesh inside for ventilation.

Each vertical section shall comprise of:

i. A minimum 2 mm thickness front framed structure of rolled/folded sheet steel channel section rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3 mm thickness and 100 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. Cable chamber housing (In rear of panel) the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. Front and rear doors fitted with dust including neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. All door shall be lockable mounted lock.

The height of the panels should not be more than 2400 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be more than 1500mm. Operating handle not higher than 1800mm. The minimum height for operating handle shall be 300 mm from floor level.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded.

The apparatus and circuits in the power control centres shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main L.T. Panel shall have the following minimum clearances.

i. Between phases - 32mm
ii. Between phases and neutral - 26mm
iii. Between phases and earth - 26mm
iv. Between neutral and earth - 26mm

For any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions. Creepage distances shall comply to those specified in relevant standards. All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.
Circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

METAL TREATMENT AND FINISH

All steel work used in the construction of the L.T. cubicle panels should have undergone a rigorous metal treatment process as follows:

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.


BUS BAR

The bus bars shall made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-9IE of IS-5082 and air insulated. The bus bars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 50KA RMS symmetrical for one second and a peak short circuit withstand capacity of 105KA. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creepage distances shall be provided on the bus bar system to minimize possibilities of fault.

The Panel shall be designed that the cables are not directly terminated on the terminals of breaker/switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium bus bars shall be considered as 0.8 Amp/sq.mm of cross section area of the bus bar. The main bus bars shall have continuous current rating throughout the length of L.T. Panel. The cross section of neutral bus bars shall be same as that of
phase bus bar for bus bars of capacity up to 200Amp; for higher capacity the neutral bus bar shall not be less than half (50%) the cross section of that the phase bus bars. The bus bar system shall consists of main horizontal bus bar and auxiliary vertical bus bars run in bus bar alley/chamber on either side in which the circuit could be arranged/connected with front access. The minimum size of vertical bus bar shall be as per fault level of panel i.e 50 KA.

In case of copper bus bars, high conductivity electrolytic grade copper with current density not less than 1.4 Amp/ sq. mm shall be used. Bus Bar shall be tinned.

Connections from the main bus bars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars to be colour coded with PVC sleeves.

Cadmium plated G.I. nuts and bolts shall be used for making bus bar to bus bar connections in aluminium bus bars.

Whenever copper bus bar and aluminium bus bar are connected to each other, bimetallic strip shall be used. In case of copper bus bar, tinning shall be done.

Bus bar calculation shall be submitted along with manufacturing drawing of panel for approval with bus bar manufacturer data sheet.

MEDIUM VOLTAGE AIR CIRCUIT BREAKER

TYPE AND CONSTRUCTION

The ACB shall confirm to the requirements of IEC 60947-2 / IS 60947-2 and shall be type tested & certified for compliance to standards from–CPRI, ERDA / any accredited international lab. The circuit breaker shall be suitable for 415 V ± 10%, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" “TRIP” indications.

Air circuit breakers shall have a rated operational voltage of 415V AC (50Hz) & impulse voltage of 12 kV.

The construction of circuit breakers shall be as per pollution degree 4 requirements to sustain harsh environments

The tests shall be carried out with a breaking performance during operation (Ics) and admissible short time withstand (Icw) equal to the ultimate breaking capacity (Icu). i.e. Icu = Ics = Icw = 50KA for 1 Sec.

The Circuit Breaker shall have minimum mechanical life of 10000 operations without maintenance.

The breakers shall deliver an electrical life of 6000 operations up to 2000A & 5000 operations for ratings 2500A and above under rated voltage of 440V AC, without maintenance.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker & shall be protected against over-load & short-circuit with provisions for settings at:

› 4P 3d - neutral unprotected,
› 4P 3d + N/2 - neutral protection at 0.5In,
› 4P 4d - neutral protection at In to ensure precise neutral protection.
Shunt trip and closing coil shall be of continuous rated design and both should be accessible from the front of ACB after opening the cover, without disturbing any other part/release.

The Circuit Breaker shall have minimum 4 changeover auxiliary contacts rated at 10 A 240/380V volts 50 Hz. There should exist, facility to add one more set of 4 contacts as required.

Ready-to-close contact shall exist for indicating that all safety parameters are checked & enabling closure of breaker, ensuring at-most safety for the user.

The withdrawable circuit breaker shall have the following three distinct and separate positions, which shall be indicated on the face of the panel.

› "Service" -- Both main and auxiliary circuits are connected.
› "Test" – All auxiliary circuits are connected & main circuits are disconnected.
› "Isolated" -- Both main and auxiliary circuits are disconnected.

There should be a positive locking at these positions while racking out or racking in for clear & confirmative indications as the position is reached. A release push button shall be available to release the lock.

A door interlock shall be provided so that it shall not be possible to open the door until the air circuit breaker moving part is in the disconnected position.

The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

The Circuit breaker protection shall be through intelligent ET range of electronic trip system suitable to protect the distribution network, against LI (Over load, Instantaneous), LSI (Overload, Short-Circuit & Instantaneous) & LSIG (Overload, Short-Circuit, Instantaneous & Ground fault).

The circuit breaker control unit shall be with display. The trip units with display shall be suitable to measure current and voltage parameters.

Control unit shall have fault history data & store last 10 trip causes.

The trip unit shall have following protection settings, based on the type of trip unit.

› Adjustable over load current (Ir) settings from 40% to 100% of rating of ACB (In).
› Over load time setting (tr) from 0.5s, 1s, 2s, 4s……24s as field selectable curves
› Short circuit setting (Isd) from 1.5 to 10 times of Ir setting
› Short circuit time delay adjustable from 0 to 400 msec.
› Instantaneous (Ii) protection with an adjustable pick-up and an OFF position.
› Earth fault setting adjustable in absolute Ampere with time delay settings from 0 to 400 ms.

**PROTECTION**

The protection release shall have following features and settings:

(i) **TRUE RMS SENSING**
The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into account the effect of harmonics also.

(ii) **THERMAL MEMORY**
When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

(iii) DEFINED TIME – CURRENT CHARACTERISTIC
A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve.

(iv) TRIP INDICATION
Individual fault indication for each type of fault should be provided by LEDs for faster fault diagnosis.

SAFETY FEATURES

(i) The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.

(ii) It shall not be possible to interchange two circuit breakers of two different thermal ratings. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.

(iii) There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.

(iv) The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.

(v) It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

(vi) Draw out breakers should not close unless in distinct Service/Test/Isolated positions.

(vii) The insulation material used shall conform to Glow wire test as per IEC60695.

(viii) The ACB shall provide in built electrical and mechanical anti-pumping.

TESTING

Testing of each circuit breaker shall be carried out at the works as per relevant IS Code of Practice and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.

ii. Power frequency withstand test.

iii. Short circuit test.

iv. Temperature - rise test under rated conditions.

MOULDED CASE CIRCUIT BREAKER

GENERAL

Moulded Case Circuit Breakers shall be incorporated in sub distribution boards wherever specified. MCCB’s shall conform to IS 13947-2 and / or IEC 947-2 in all respects. MCCB’s shall be suitable
either for single phase AC 230 volts or three phase 415 volts. All MCCB shall be provided with rotary operating mechanism.

All MCCBs shall be suitable for 3 Phase 415 Volts AC 50 HZ supply.

All MCCBs shall have rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at defined operational voltage.

All MCCBs shall clearly indicate the suitability for isolation in the name plate identified by the symbol .

All MCCBs shall offer class –II front face i.e. main current path of the circuit breaker should be isolated from auxiliary section

All MCCBs shall have cross bolted termination.

All MCCBs above 250A shall have the following features:

- Single frame size with common accessories to reduce inventory
- Microprocessor trip unit
- Adjustable overload settings – 0.5-1 In
- Adjustable Short circuit – 2-10 Ir
- Adjustable neutral for 4P MCCBs – 0-0.5Ir-1Ir
- Thermal memory
- Test connector to check the healthiness of trip unit
- 4000 electrical operations
- ON/OFF/Trip/Push to trip indication contacts

All MCCBs up to 250A shall have following features:

- Single frame size with common accessories to reduce inventory
- Thermal magnetic trip unit
- Adjustable overload settings – 0.7-1 In
- Fixed short circuit settings
- Fully rated neutral for 4P MCCB
- 10000 electrical operations
- ON/OFF/Trip/Push to trip indication contacts

Individual fault trip LED indications shall be available on all types of trip units for easy & faster identifying the cause of fault.

I’t ON / I’t OFF options shall be available for short-circuit & earth fault protections to enhance discrimination with downstream devices.

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

The release shall be self diagnostic type with clear LED indication in case of mal functioning.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched off while adjusting the setting.

Circuit breakers shall conform to Electromagnetic compatibility tests (EMC) as specified in IEC 60947-2, Appendix F.

Manufacturer shall submit the test certificates for the same.
The control unit shall have **thermal memory** throughout the range to store temperature rise data in case of repetitive overload or earth fault for protecting the cables and loads.

**RUPTURING CAPACITY**

The Moulded Case Circuit Breaker shall have a minimum fault breaking capacity (Ics) of not less than 50KA RMS at 415 volts or as specified in BOQ./ Drawing.

**TESTING**

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished. Pre-commissioning tests on the sub distribution boards incorporating the MCCB shall be done as per standard.

**MEASURING INSTRUMENT FOR METERING**

**GENERAL**

The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

**DIGITAL AMMETERS**

Digital Ammeters shall be confirm to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

**DIGITAL VOLTMETERS**

Digital Voltmeters shall be confirm to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltimeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

**CURRENT TRANSFORMERS**

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 15A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

- **Measuring**: Class 1.0
- **Protection**: Class 5 P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.
Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

CONTROL SWITCHES

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

CABLE TERMINATION

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminiums conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

CONTROL WIRING

All control wirings shall be carried out with 1100V grade single core PVC cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

TERMINAL BLOCK

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

LABELS

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.
MISCELLANEOUS
Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

BATTERY AND BATTERY CHARGER

A set of 24V DC power supply shall be provided for indication, relay operation etc. for Main L.T. Panel. DC Power supply shall be sealed maintenance free batteries of suitable capacity. Suitable battery chargers shall also be provided to charge the battery to perform during mains failure.

CAPACITOR BANK PANEL
Medium Voltage Capacitors and Control Panel to be used for improvement of power factor of the electrical system and shall be connected to Main L.T. Panels through L.T. Cable / L.T. Bus ducts. Automatic Power Factor Correction Panel shall function to improve power factor of the system in which it is connected. It shall improve power factor up to 0.99 from existing value.

CODES AND STANDARDS-
Unless otherwise specified the capacitor and control panel shall conform to following.

a. IS: 2834 - Shunt capacitors for power systems.
b. IS: 2147 - Degree of protection provided by enclosures for low voltage switchgear and control gear.
c. IS: 4237 - General requirements for switchgear and controlgear for voltages not exceeding 1000V.
d. IS: 8623 - Specification for factory built assemblies of switchgear and control gear (Up to 1000 volts).
e. IS: 2208 - HRC cartridge fuse links up to 650 volts.
f. IS: 4064 - Specification for Fuse Switch & Switch Fuse switchgear and control gear.
g. IS: 2959 - AC contactors for voltage not exceeding 1000 volts.

SUBMITTALS

SHOP DRAWING AND TECHNICAL DATA
Complete technical data sheet including guarantee details giving the temperature rise, capacitor losses etc, Capacitor panel GA drawing, indicating mounting of capacitor units shall be furnished with the shop drawing.

SPECIFICATION

CAPACITORS

i. The capacitor shall be 3 phase heavy duty box type capacitor 525 Volt, 50 Hz, with 14% detuned reactor.
ii. The temperature rise above the specified ambient (50°C) of any part of the capacitor and polyurethane resins associated equipment shall not exceed the permissible temperature as per IS: 2834.

iii. 50/25/10/5 KVAR capacitor units shall be used to form a bank of capacitors of desired capacity. All these units shall be connected in a parallel by means of solid bus bars of adequate current carrying capacity. The combination of capacitor unit shall be such as not to exceed permissible over voltage across the healthy capacitor units in case of failure of one or more units. Capacitor banks shall be suitable for operation at 110% of rated RMS voltage and 150% of rates RMS current. Each unit shall satisfactorily operate at 135% of rated KVAR.

iv. Construction-

The Capacitor banks shall be floor mounting type using minimum floor space. The container of capacitors shall be hermetically sealed in sturdy containers made out of 2 mm thick M.S. sheet steel. Dry type or synthetic non-inflammable oil shall be used for insulation. Each standard unit shall be provided with a built in silvered fuse.

v. Discharge Resistance

Each capacitor unit shall be individually protected by MCCB with indication to show when it is in operation. The capacitors shall be provided with permanently connected discharge resistors so that residual voltage of the capacitors shall be reduced to 50 Volts or less within one minute after the capacitor is disconnected from the sources of supply.

vi. Earthing

Two separate earthing terminals shall be provided for earth connection for each bank. All components and frame shall be properly earthed.

CONTROL PANEL

The panel shall be provided with necessary MCCB’s, contactors, automatic required steps relays with associated CT’s and power factor meter, indicating lamps, push buttons etc. Capacitors shall also be housed in the same panel. The panel shall be free standing type, dead front cubicle and shall be constructed from 2 mm thick sheet steel. The degree of protection shall be IP 54. This panel shall be integrated with the main L.T. panel unless specified otherwise.

PAINTING

As the capacitor panel is integrated with Main LT panel, it shall be painted as per specification in relevant Clause above.

SUB DISTRIBUTION PANEL

GENERAL

Sub Distribution Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.
STANDARDS

The equipment shall be designed to conform to the requirements of:

IS 8623 – Factory Built Assemblies of switchgear and control gear.

IS 4237 – General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

IS 2147 – Degrees of protection provided by enclosures for low voltage switchgear and control gear.

IS 375 – Marking and arrangement of bus bars.

Individual equipment housed in the sub distribution boards shall conform to the following IS specifications:


b) Miniature Circuit Breaker - IEC - 60898

c) Contractors - IEC – 947-4-1, IS 13947-4-1

d) Current Transformers - IS: 2705

e) Indicating Instruments (Analogue) - IS: 1248,

f) Indicating Instruments (Digital) - IS: 13875

g) Integrating Instruments (Analogue) - IS: 722, IS: 13779-1999

h) Integrating Instruments (Digital) - IS: 13779- 1999, IS: 14697

i) HRC fuse links - IS: 13703 / IEC 269

SUBMITTALS

Shop Drawings And Technical Data

The tenderer shall furnish relevant technical data of switchgears and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on switchgears and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams and control wiring.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) All drawings and data shall be in English.
CONSTRUCTIONS

Sub Distribution boards shall be metal enclosed, indoor, floor mounted free standing and/or wall mounted type made up of the required vertical section, which when coupled together shall form continuous dead front. Sub distribution boards shall be dust and damp protected, the degree of protection being no less than IP: 54 to IS:2147. Sub distribution boards shall be fabricated with a framed structure with rolled/folded sheet steel channel section of Sheet steel shroud and partitions shall be of minimum 2mm thickness, doors and covers shall also be of 2mm thickness. All panel doors shall be pad lockable type. All sheet steel work forming the exterior of sub distribution boards shall be smoothly finished, leveled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust proof including neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearance to be maintained after taking into account connecting bolts, clamps etc.

i) Between Phases - 32mm
ii) Between Phases and neutral - 26mm
iii) Between Phases and earth - 26mm
iv) Between Neutral & earth - 26mm

All insulating, materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. SMC (Sheet Moulded Compound) supports & shrouds shall be used.

Functional units such as moulded case circuit breakers shall be arranged in multi-tier formation. The design of the sub distribution boards shall be such that each MCCB unit shall be fully compartmentalized.

Insulated barriers shall be provided with vertical section and between adjacent section to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fastness to prevent unauthorized access. Sub distribution boards shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables.

For each cable alley, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3 mm thick.

A base frame made out of 75mm x 40mm x 5.0mm M.S. Channel to be provided.

METAL TREATMENT AND FINISH

All metal work used in the construction of the sub distribution boards should have undergone a rigorous metal treatment process as follows:

a) Effective cleaning by hot non alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution

b) Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

d) Passivating in de-oxalite solution to retain and augment the effects of phosphating.

e) Drying with compressed air in a dust free atmosphere.

f) A finishing coat of powder coating of Siemens grey colour and thickness of powder coating shall not be less than 50 micron.

**BUS BARS**

The bus bars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade E-91E.

The bus bars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 35KA RMS symmetrical for one second or as specified in BOQ/Drawing and a peak short circuit with stand capacity of 105 KA.

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creepage distance shall be provided on the bus bar system to minimize the possibility of fault. The main phase bus bars shall have continues current rating throughout the length of the panel. The cross section of neutral bus bars shall be same as that of the phase bus bar for bus bars of capacity up to 250 Amp; for higher capacities, the neutral bus bar shall not be less than half (50%) the cross section of that of the phase bus bars. Connections from the main bus bars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars shall be colour coded with PVC heat shrinkable sleeves.

The sub distribution boards shall be designed that the cables are not directly terminated on the terminals of MCCB etc. but are terminated on cable termination links. Capacity of aluminium bus bars shall be considered as 0.8 Amp per sq. mm of cross section area of the bus bars.

**MEASURING INSTRUMENTS, FOR METERING:-**

**GENERAL**

Direct reading electrical instruments shall be in conform to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.
The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

**DIGITAL AMMETERS**

Digital Ammeters shall be confirm to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

**DIGITAL VOLTMETERS**

Digital Voltmeters shall be confirm to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

**CURRENT TRANSFORMERS**

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

<table>
<thead>
<tr>
<th>Category</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring</td>
<td>1.0</td>
</tr>
<tr>
<td>Protection</td>
<td>5 P10</td>
</tr>
</tbody>
</table>

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

**CONTROL SWITCHES**

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.
Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

CABLE TERMINATIONS-

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

CONTROL WIRING-

All control wirings shall be carried out with 1100V grade single core FRLS cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

TERMINAL BLOCK-

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

LABELS-

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

TESTING AT MANUFACTURING WORK-

All routine tests specified is IS: 8623-1977 shall be carried out and test certificates submitted to the Engineer – in –Charge.

TESTING AND COMMISSIONING-

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check

c) Insulation test: When measured with 500 V meggar, the insulation resistance shall not be less than 100 mega ohms.

d) Trip tests & protection gear test.
DISTRIBUTION BOARDS

GENERAL

a) Distribution Board shall be double door type with extended loose wire box & M.S. Junction Box at the top and suitable for flush installation. All distribution boards shall be of three phase (415 Volts) or single phase (240 Volts) type with incoming isolator or MCB and/or ELCB as in Bill of Quantities. Distribution boards shall contain plug in type miniature circuit breaker mounted on bus bars. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS 8828-1978 & IS 8828 - 1996. Bus bars shall be of electrolytic copper. Neutral bus bars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Separate neutral & earth bus bar link to be provided for each phase. Phase barrier shall be fitted and all live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have an etched zinc base stove painted followed by synthetic stoved enamel, colour light gray. A circuit identification card in clear plastic cover shall be provided for each distribution board. IK (Mechanical Stress) rating of distribution board enclosure shall not be less than IK –07/08/09.

b) Distribution Board with single phase outgoings requirement shall be Horizontal type. Distribution Board with three phase outgoings requirement shall be Vertical/ Horizontal type. Distribution Board installed in indoor dry locations shall conform to IP-42. Distribution Board installed in outdoor & wet locations shall conform to IP-65.

c) miniature Circuit Breakers for lighting circuits shall be of "B" series where as the circuits feeding discharge lamps (HPMV or HPSV) halogen lamps, all power outlet points, equipment/machinery shall be of "C/D" series (Motor circuit) types. All miniature circuit breakers shall be of not less than 10KA rated rupturing capacity. All miniature circuit breaker terminal shall have safety shutter.

d) Distribution board shall be provided with isolator or MCB and/or earth leakage circuit breaker as mentioned in drawings and BOQ. Earth leakage circuit breaker shall be current operated type and of 30mA sensitivity unless otherwise stated. ELCB shall be mounted within distribution board box for single phase distribution board while in three phase distribution board ELCB shall be either mounted within distribution box or in a separate MS box below distribution board. Width and depth of ELCB box shall be same as that of distribution board box and of same finish. Height of ELCB box shall be sufficient to accommodate ELCB & termination of incoming & outgoing wires. Distribution board box, isolator, MCB’S used shall be of one/same manufacturer. Standard size manufactured by approved manufacturer shall be used. In case size specified in BOQ is not standard size of manufacturer, in that case next standard size distribution board box shall be used with incoming & outgoing MCB as specified in BOQ. Additional cutout/space for outgoing MCB shall be plugged with blank plates. No extra cost shall be paid for using bigger/higher size distribution board box and blank plates.

CONDUIT AND WIRING SYSTEM

PVC CONDUIT

Conduits shall be heavy gauge rigid PVC of minimum thickness of 2mm. Conduits shall be ISI marked confirming to IS: 9537 (Part-3)-1983. All conduit and conduit accessories shall be of PVC. Conduit shall
be jointed together by a vinyle type cement/solvents. Minimum size of conduit shall be 25mm unless otherwise mentioned in BOQ or drawing. Conduit shall be fixed on ceiling or wall. All conduits shall be concealed in wall/ceiling etc. or fixed on surface of wall with clamps at regular interval as called for elsewhere. For termination of PVC conduits into switch outlet box, PVC female adopters shall be used. Wherever conduit run exceeds 10 metre, circular junction boxes shall be provided to facilitate pulling & inspection of wires. Inspection boxes shall be suitably located in co-ordination with the Engineer-in-charge. Conduits shall be bend using suitable size springs. Long radius bends shall be provided. Heating shall not be used to bend the conduits. Size of conduit shall depend upon number and size of wires to be drawn.

M.S. CONDUIT

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS code. No steel conduit less than 20mm in diameter shall be used unless otherwise stated.

CONDUIT JOINTS

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13mm to 19mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipe shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

Wherever conduit passes a building expansion joint, galvanized flexible metallic conduit shall be provided for connecting rigid M.S. Conduit in either slab.

PROTECTION AGAINST CONDENSATION

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

PROTECTION OF CONDUIT AGAINST RUST

The outer surface of conduit including all bends, unions, tees, junction boxes etc forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

PAINTING OF CONDUIT AND ACCESSORIES

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.
FIXING OF CONDUITS

SURFACE CONDUIT

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other 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 30cm from the centre of such fittings. The saddles should not be less than 24 gauge for conduits up to 25mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19mm & 25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Where as it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used. All fixing arrangement like saddles, special purpose clamps, nuts, bolts etc. shall deemed to be included in quoted rates of conduit.

For 25mm diameter conduit width of clip shall be 19mm and of 20 SWG. For conduit of 32mm and above, width of clip shall be 25mm and of 18 SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer-In-Charge at site.

RECESS / CONCEALED CONDUIT

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. 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. Entire work of chasing the wall, fixing the conduit in chases, and during the conduit in mortar before plastering shall form part of point wiring work. (For chase cutting-chase cutting machine shall be used and no manual cutting shall be allowed)

The conduit pipe shall be fixed by means of stapples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius which shall permit easy drawing in of conductors. All threaded joint of conduit pipe shall treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 metres, then circular junction box shall be provided to facilitate pulling of wires. The chicken wire mesh shall be provided by civil agency.

OUTLET BOXES:

Switch/outlet boxes shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Upto 20 x 30cm size M.S. Box shall have wall thickness of 16 SWG and MS boxes above 20x30cm size shall be of 14 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. all fitting shall be fitted in flush pattern. Switch/outlet boxes shall be suitable to house modular type light and power accessories. Earthing
stud to be provided for connection of earthing wire in side of box at near any corner. Nakka shall be 3 mm thick.

**FAN BOX:-**

Fan Box shall be made out of 14 gauge M.S. sheet in hexagonal shape. The dia of box shall be 150 mm and depth of box shall be 80 mm. A M.S. cover plate size 160 mm x 160mm x 16 gauge to be provided in the back of fan box. 12 mm dia M.S. Rod to be provided for fan hanging arrangement in the box. A 28 mm dia knockout To be made in all six hexagonal vertical part for conduit entry in the box. The box shall be painted with 2 coat of primer. A 180 mm dia , 2 mm thick hylem sheet Cover to be provided. (The sample to be approved before procurement / execution by owner / consultant.)

**JUNCTION TEE / DEEP TEE :**

The tee shall be made out of C.I. material. The dia of tee shall be 60 mm and the Depth of tee shall be 70 mm. The thickness of deep tee wall shall be 1.3mm to 1.5mm. (The sample to be approved before procurement/execution by owner / consultant.)

**ERECTION AND EARTHING OF CONDUITS:-**

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit. Gas, water pipe shall not be used as earth medium.

**LIGHT & POWER ACCESSORIES:-**

**GENERAL**

All light & power accessories shall be of modular range of plate switch type and shall be of one manufacturer (brand) and type.

**LIGHT SWITCHES**

All switches for control of light shall be of 6/10 Amp unless otherwise stated. All switches shall be modular range of plate switch type. The switches shall be rocker mechanism type with silver contact. All switches shall be of white finish or as sample approved by owner/consultant.

**6/16 AMP SWITCH SOCKET OUTLET.**

Switch socket outlet on lighting circuit shall be of 3 pin 6Amp outlet shall have safety shutters. The switch shall be of rocker mechanism type with silver contact. Socket outlet shall be shutter type and of modular range of plate type and having white finish. Switch and socket outlet shall be mounted on a suitable size GI box with suitable size modular cover plate.

Switch socket outlet on power circuit shall be of 6 pin 16/6 Amp outlet (Universal Socket) shall have safety shutters. The switch shall be of rocker mechanism type with silver contacts. Socket outlet shall be shutter type and of modular range of plate type and having white finish. Switch and socket outlet shall be mounted on a suitable size G I box with suitable size modular cover plate.
TELEPHONE OUTLET

Each Telephone outlet location shall be provided with 1 No. telephone Jack type outlet (RJ11). The telephone outlet shall be of modular range of plate switch type and shall be mounted on a suitable size GI Box with modular range cover plate.

WIRING

All FRLS insulated copper conductor multi-stranded wires shall conform to relevant IS codes. Cable conductor size and material shall be as specified in BOQ.

All internal wiring shall be carried out with FRLS insulated wires of 1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switch board may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switch boards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red or yellow or blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FRLS insulated wire for RYB phase wire respectively and black colour FRLS insulated wire for the neutral wires. FRLS insulated green colour wire shall be used as earth continuity conductor and shall be drawn alongwith other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications.

JOINTS

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

SUB MAINS

Sub-main wiring shall be carried out with FRLS Insulated Copper multi-stranded wires/cables in suitable M.S Conduit unless otherwise specified in BOQ / drawing.

Sub-main cable where called for shall be of the rated capacity and approved make. Every sub-main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the sub-main cables. Cost of junction box/drawn box is deemed to be included in the rates of sub-main wiring. An independent FRLS insulated copper earth wire of proper rating shall be provided for every sub-main. Single phase sub-main shall have single earth wire whereas three phase sub-main shall be provided with two earth wire.

Where sub-mains cables are connected to the switchgear, sufficient extra lengths of sub-main and mains cable shall be provided to facilitate easy connections and maintenance. For termination of cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed.
LOAD BALANCING

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

COLOUR CODE FOR CIRCUIT & SUB-MAIN WIRING

Colour code for circuit & sub-main wiring installation shall be Red, Yellow, Blue for three phases. Black for neutral and green for earth in case of insulated earth wire.

CLASSIFICATION OF POINTS:

General

Classification and measurement of Point wiring shall be as follows:

Conduiting & wiring from switch to first point including circuit wiring along with conduits, shall be classified as “One point (First point) controlled by one number 6Amp one way/two way switch”.

Conduiting & wiring from first point to next point to be controlled by same switch in same circuit shall be classified as “Looping Points”.

CONDUCTOR SIZE

Wiring shall be carried out with following sizes of FRLS insulated multi-stranded single core copper conductor wire/cable.

- Light point: 1.5 Sq.mm
- Ceiling/Cabin/Exhaust Fan Point: 1.5 Sq.mm
- Plug Point (5 A SS outlet): 1.5 Sq.mm
- Circuit Wiring: 2.5 Sq.mm
- MCB Control Light Point: 2.5 Sq.mm
- General Power Point (15A S.S. outlet)-First Point: 2.5 Sq.mm
- General Power Point (15A S.S. outlet)-Second Point: 2.5 Sq.mm
- Power Point for Geyser / A.C. Unit: 4.0 Sq.mm

TELEPHONE WIRE/CABLES:

Separate conduits shall be provided for internal telephone wiring of telephone system commencing from tag block. Each telephone outlet shall be wired with 2 pair telephone cable from the tag block. All telephone wires shall be of 0.5mm dia annealed tinned high conductivity copper conductor PVC insulated & PVC sheathed grey conforming to ITD specification SWS 113 B&C. Multipair PVC insulated cables laid in conduit shall be provided for connecting various tag blocks. Telephone cables used for external connections shall be armoured. These cable shall be laid directly in ground or in pipe etc. as call for elsewhere.

Following number of 2 pair wires/cables shall be drawn in various sizes of conduits as listed below.

- 25mm conduit: Up to 6 Cables
All telephone cables used in the building shall be PVC insulated PVC sheathed.

**TELEPHONE DISTRIBUTION BOARDS (TAG BLOCK):**

Tag block shall be mounted in M.S. box fabricated from 1.63 mm thick sheet steel. Box shall undergo a rigorous metal treatment process i.e. degreasing, pickling, phospating, pasivating in de oxalate solution, dry with compressed air in dust free atmospheric facility and disconnection module shall be in multiple of 10 pairs. Disconnection unit shall be mounted on back mounting frame.

**SUPPORTS AND INSTALLATION OF LIGHT Fixture:**

**SUPPORTS AND FIXINGS**

Where fluorescent luminaries 1200 mm or more in length are supported directly by the conduit system they shall be fixed with light point junction boxes of which shall form an integral part of the conduit system.

Where the weight of the luminaire is supported by a conduit box or cable trunking the fixing of the conduit box or trunking shall be adequate for the purpose and approved by Architect/Consultant.

Luminaires fitted with tungsten filament, lamps and having metal back plates shall not be fixed directly to conduit box in which a thermoplastic material is the principal load-bearing member.

Support of luminaires from cable trunking shall be by means of appropriate clamps or brackets.

Luminaires mounted on or recessed into suspended ceilings shall not be support on the false ceiling unless specifically shown and approved.

For wall mounted luminaires, the mounting height specified on drawings shall be above finished floor level measured to the centre of the conduit box, unless otherwise indicated.

**WIRING CONNECTIONS**

Where luminaires, other than those are fixed direct to circular boxes or supported by pendants or chains, the final circuit wiring shall terminate at a terminal block in the conduit box.

Where luminaires having fluorescent tubes are fixed direct to circular conduit boxes, the final circuit wiring may be terminated within the luminaire unless otherwise indicated. The wiring shall enter each luminaire at the conduit entry nearest to the terminal block and where the loop – in wiring system is used leave by same entry wiring shall not pass through a luminaire.

Where luminaires are mounted on or recessed into a suspended ceiling connection shall be by flexible cord from a plug in ceiling rose shall be located not more than 500 mm from the access panel in the ceiling and shall be firmly supported, unless otherwise approved by the consultant.

Cables and flexible cords for final connections to luminaires shall be suitable for the operating temperature of the luminaire. Flexible cords for chain suspensions, if any shall have a white sheath unless otherwise indicated.

The size of final connection cables or flexible cords shall be as indicated.

Cables and cords passing close to ballast within a luminaire shall be suitable for the operating temperature of the ballast. Heat resistant sleeves shall be provided.
A protective conductor shall connect the earthing terminal or earthing contact of each luminaire to an earthing terminal incorporated in the adjacent conduit box. Where the final connection is by flexible cord the protective conductor shall form part of the cord.

Where luminaires are recessed in the false ceiling, luminaires shall be suspended with MS conduit with ball & socket arrangement, check nut etc. Suspension arrangement shall be fixed to steel/RCC structure with suitable purpose made clamps etc. (Cost of suspension arrangement is deemed to be included in the rate of installation/erection of luminaires). Contractor shall submit the shop drawing for proposed suspension arrangement of various types of light fixtures in various type of ceiling and shall obtain necessary approval from the Engineer-in-Charge.

The light fixtures and fans shall be assembled and installed in position complete and ready for service in accordance with the detailed drawings, manufacturer’s instructions and to the satisfaction of the Engineer-in-Charge. Fixtures shall be suspended true to alignment plumb level and capable of resisting all lateral and vertical forces and shall be fixed as required. All ceiling fans shall be provided with suspension arrangement in the concrete slab/roof members. It shall be the duty of the contractor to make these provisions at the appropriate stage & locations shown on the drawings. Fan box with MS hook shall be as per CPWD specifications. Suspended type fluorescent light fixture shall be fixed to circular junction box with a metallic ball and socket arrangement. Light fixture in general shall be directly fixed to ceiling slab with rawl plugs. All switch and outlet boxes shall be bonded to earth through connector blocks. MS pipe shall be fixed with suitable fixing accessories and metal continuity shall be maintained.

**CONDUITING AND WIRING FOR SAMTV SYSTEM:**

**CONDUITING**

Conduit for SMATV system shall be carried out in M.S. Conduit. Conduiting shall be carried out as specified in point wiring head.

**OUTLETS**

All SMATV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.

**JUNCTION BOX**

Suitable size of metallic junction box shall be provided for termination of conduit for SAMTV system. Box shall be made of 1.6mm thick MS sheet and shall be treated before painting. Front of the junction box shall be provided with 3mm thick phenolic laminated sheet cover.

**COAXIAL CABLES**

The coaxial cable shall be of wideband type (RG-11 for Riser & RG-6 for distribution)

**TAP OFF**

These shall be of ultra wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance.

The Tap offs shall be in one way, two way and four way configurations.
SPLITTERS

These shall be of ultra wide band width and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminum cast housing for high frequency radiation resistance.

The splitters shall be in 2 way, 3 way & 4 way configurations

LIGHTNING PROTECTION

GENERAL

1. The advance lightning protection system shall be of the enhancing type designed to attract lightning from a predetermined volume and to safely convey the lightning current to earth through a known and preferred route.
2. The lightning protection system shall include components as follows: air termination(s) mechanical support(s), down conductor(s), performance recording equipment, and low impedance grounding system.
3. The Advanced Lightning protection system shall be mounted adequately rated for wind shear loading. Guying kits shall be provided as appropriate to local environmental conditions, or based on mast arrangement selected.
4. The Advanced Lightning protection shall be designed by a company engaged in the manufacture and development of Advanced Lightning system components, of types, sizes and ratings as shown, who can show evidence or support that their products have been in satisfactory service for not less than 10 years.
5. The lightning protection components (Air termination(s) and down conductor(s)) shall be compliant to UL-96.

AIR TERMINATION

1. The air termination shall be Controlled Leader Triggering / Controlled Streamer Emission (CSE) terminal
2. The air termination shall be working on the principle of Collection Volume Method Placement and Electric Field Intensification which responds dynamically to the appearance of a lightning down leader by creating free electrons needed to initiate an upward streamer and sudden increase in the electric field above the air terminal which provides the additional energy to initiate and convert a strong propagating upward leader.
3. The air terminal should have variable impedance unit for discharging the static charges into the ground during the buildup stage in the atmosphere.
4. The air termination shall be non-radioactive
5. Arcing is not to be continuous and shall only occur during the progress of the lightning leader. Arcing shall not occur solely due to electrostatic field when a thunderstorm is overhead except when there is leader activity in the region.
6. The external shape of the terminal shall be of Stainless Steel Semi Spherical type in order to significantly reduce the buildup of sharp point corona discharge under static field thunderstorm conditions.
7. The air termination shall be passive terminal not requiring internal or external power source for its operation. It shall have no moving parts and the materials of the air termination shall be non-corroding in normal atmosphere.
8. The materials of the air termination shall be non-corroding in normal atmosphere. The centre earthed finial shall be at least 300mm² in cross section and be made of electric grade non ferrous material. The outer metallic surfaces of the terminal shall be manufactured of anodised aluminium.
9. The air termination shall be insulated from the protected structure under all conditions.
10. The size of the collection volume and attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.
11. The termination shall be mounted a minimum of 10 metres from the ground.
12. The air termination(s) shall be compliant to UL-96: Lightning Protection Components (Standard for Safety).
13. The air termination shall be installed strictly to the manufacturer's instructions. It shall not be installed in corrosive environments or atmospheres without prior written approval from the manufacturer.
The protective zone provided by the air termination shall be such that it becomes the preferred strike point for all discharges exceeding a peak amplitude return strike current of \( X \) kA according to the statistical level \( Y \) per IEC61024. The design shall take account of upward leader competing projections on the structure.

<table>
<thead>
<tr>
<th>Strike Current (X)</th>
<th>Levels of Protection (Y)</th>
<th>Exceedance Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9 kA</td>
<td>Protection Level I – Very High</td>
<td>99%</td>
</tr>
<tr>
<td>5.4 kA</td>
<td>Protection Level II- High</td>
<td>97%</td>
</tr>
<tr>
<td>10.1 kA</td>
<td>Protection Level III – Medium</td>
<td>91%</td>
</tr>
<tr>
<td>15.7 kA</td>
<td>Protection Level IV – Standard</td>
<td>84%</td>
</tr>
</tbody>
</table>

**AIR TERMINATION SUPPORT**

The air terminal support shall consist of a minimum of 2m of insulating re-enforced fiberglass cylindrical mast. The conductor shall pass through the centre of the mast, with the high voltage termination contained to the upper 1m of the mast.

The support shall be securely bolted to other mast materials with guy wires used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

**DOWNCONDUCTOR**

1. The down conductor shall consist of a plastic filler, copper conductor, inner insulation, outer copper conductor, conductive sheath, all concentrically arranged.
2. The characteristic of the Down Conductor should be as follows:
   i. Characteristics impedance of less than 12 \( \Omega \).
   ii. Inductance of 37 nH/m.
   iii. Capacitance of 0.75 nF/m.
   iv. Upper Termination Voltage Withstand of 250 kV.
   v. Resistance \( R_{DC} \) of 0.5 m\( \Omega \)/m and \( R_{IMPULSE} \) of 6 m\( \Omega \)/m
   vi. Cross Sectional Area of 55 sq. mm
   vii. Maximum diameter of 36 mm.
   viii. Weight of 1.2 kg/m.
3. The Down Conductor should discharge the lightning current to the ground with minimum danger of side flashing.
4. The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to bends of less than 0.5 metres radius.
5. The down conductor after routing, must be kept in constant physical contact with the structure via conductive clamps. The top 10% of the installed length from the terminal must be anchored at least every 1 metre. The lower must be anchored at least every 2 metres.
Performance recording equipment

Each protection system shall be supplied with a lightning event counter. The lightning event counter shall have a register that activates one count for every discharge where the peak current exceeds 1500A. The test wave shape shall be the 8/20us standard as defined by ANSI C62.41

The lightning event counter shall be robust, easy to install and housed in an IP67 rated enclosure. The counter shall operate from the energy of the lightning discharge and not rely on external or battery power to operate.

The lightning event counter shall be installed to the manufacturer’s instructions in a readily accessible manner so that readings can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -10°C to +50°C.

Lightning Protection Maintenance Free Earth:

The grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the Advanced lightning protection system.

The earth should be done with minimum 4 nos of Copper Bonded Ground Rods of 250 Microns with 5 ft length and 5/8” diameter in single line or square depending on site conditions.

The earth rods be grounded and joined with minimum 25 meters of 99.9% pure 25 mm x 3 mm Copper Strip.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building and to arriving services is recommended. The resistance should be measured and the 10 ohms maximum figure achieved before such bonding is done.

Electrically conductive, non soluble Earth Enhancing Material may be used to help achieve low ground resistance provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

FIRE ALARM SYSTEM

DESCRIPTION:

The work shall consist of furnishing, installation, testing & commissioning of a complete high quality advanced technology early detection Intelligent Analogue Soft Addressable fire alarm system as shown on the drawings and specified herein.
REFERENCES FOR INSTALLATION:

German Standards VDE (Verband Deutcher Electrotechniker) DIN  VDE14675 and VDE 0833 Fire Alarm Systems
NFPA- National Fire Protection Association NFPA 72

British Standard Institute / European Standards
All Applicable codes and standards including BS EN 54

SUBMITTALS:
A. Product data for fire alarm system components including dimensioned plans, sections, and elevations showing minimum clearances, installed features and devices, and list of materials and data.
B. Shop drawings.
C. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project.
D. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with any one of the referenced standards, completely with specifications and Vds approval/UL.

TRANSPORTATION, HANDLING AND STORAGE:
A. All the components of fire alarm system shall be provided in manufacturer’s original new and unopened packing bearing manufacturer’s name and label.
B. Store materials, not in actual use, in covered and well ventilated area and protect them from dirt, dust, moisture, direct sunlight and extreme temperatures.
C. For further requirements follow manufacturers written instructions regarding storage and handling.

WARRANTY
A. Submit written guarantee signed by the contractor, manufacturer and installer of fire alarm system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

QUALITY ASSURANCE:
A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of fire alarm systems and components, whose products have been in satisfactory use in similar services for not less than 3 years period, and be subject to approval of engineer.
B. Installer Qualifications: An experienced specialist sub-contractor who is authorized by the system manufacturer, and subject to approval of the engineer.
C. All the components and installations shall comply with the requirements of DIN VDE 14675 & VDE 0833/NFPA for design & installation.
D. Provide system and components specified in this section that are listed and approved by Vds & confrom to equivalent DIN/EN/UL standards.
E. Single source responsibility: All components and accessories shall be product of single manufacturer.

**SYSTEM DESCRIPTION:**

A. The fire detection and alarm system shall comprise of Automatic Soft Addressable Modular design main fire alarm control panels, Dual optical smoke & heat MULTI Sensors, Blue LED Optical Smoke & Heat MULTI Sensors, Optical Smoke / Heat/ CO Gas MULTI sensors, Loop powered Dual Optical Smoke/Heat sensor with integral Sounder / Flasher / Speech units, manual call points, electronic wall mounted Alarm sounder/flasher/speech combined devices, Transponder interface units, each with its own short circuit built-in isolators. All loop cabling and any other components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of DIN EN 54. The system shall be fully programmed to accommodate fire alarm zones. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to existing buildings/network on site.

B. The fire alarm and detection system shall provide the following facilities as a minimum:

   The system shall be intelligent in operation with advanced decentralised intelligence technology. Each detector shall have its own processor with algorithms built in the device to take a fire or fault decision. System with centralised intelligence by providing signal levels to the control panel are not acceptable.

   The system will be capable of providing fire, fault disablement and supervisory monitoring facilities as required by DIN EN 54 Pt 2. All devices on a loop shall have built in SHORT CIRCUIT LINE ISOLATORS for wiring fault isolation to protect the system. “Group Circuit Monitors” which isolate/protect sections of a loop circuit, i.e. a group of field devices are not acceptable.

   All system components and devices shall be connected to two-wire loop circuits (as shown in the typical schematics) with each component having its own individual built-in isolator, should have sensors with integrated sounder in a same unit and no extra cabling should require to power up the sounder. Removal or disconnection of any component from the loop shall not affect the functioning and performance of other components and the system. Please note that the group isolators, which are used to isolate a section of a loop in case of fault, are not acceptable.

   System shall be of automatically addressable type i.e. all the devices on the loops of the FACP shall be allocated addresses automatically from the PC / panel at the time of system power. The loop devices shall also be able to commission by using PC interface without the need of FACP.

   And also given an address during commissioning, the value of which shall be stored in non-volatile memory, within the electronics module of the outstation. This value shall be read during loop allocation and provided it is valid shall be used to setup the outstations primary address.

   Automatic Addressing shall cover the benefits of Soft Addressing and also overcome the limitations of Hard Addressing. This means that If the devices are inserted or removed all the existing devices shall keep the same address and programmed activations and use labels remain unchanged. The panel with PC shall allocate the address to ensure that it is impossible for two devices to have the same address. Fire Detection and Alarm Systems, which rely only on Coding, Programmer or hard addressing techniques are not acceptable.

   Facilities shall be provided to constantly monitor and check the following circuits and fault conditions:

   - The power supply to the loop/s;
   - For open-circuit, short-circuit, earth fault and any other fault condition in the loop wiring;
   - For communication failure and errors in all cards and loops
   - For faults in keyboard and printer circuits
   - All devices, etc. shall be installed on the same loop.
All devices shall be assigned a maximum of 25 character or 2 lines of max. 30 characters each with a ¼ VGA Display. In case of fire, fault or warning, the label of device sensing threshold shall appear on visual display unit of the panel.

Any event i.e. Fire, fault or warning shall be recorded with time, date and place of occurrence in the memory of FACP. These events can either be displayed on normal or ¼ VGA Display of the FACP or printed, as required. Provision shall be done at the fire alarm control panels to silence the loop powered alarm sounders but the visual indication shall remain until the system is reset. The detectors shall have auto learn sensitivity adjustments. The main fire alarm control panels shall be located as shown on the schematics and the floor drawings.

GENERAL

All major component of fire alarm system shall be product of a single manufacturer and shall conform to the requirement of EN54, Vds,UL approved and be designed acc. to DIN  VDE14675 and VDE 0833/NFPA Fire Alarm Systems CODE OF PRACTICE FOR SYSTEM DESIGN, INSTALLATION AND SERVICING.

The power supply breakers for FDA system shall be marked “ DO NOT DISCONNECT. FIRE ALARM SUPPLY”

ANALOGUE ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)

A. In the event of a fire being reported from the smoke/heat Detectors, activation of manual call points or sprinkler operation the sequence of alarm operation shall be as follows: If a fire condition is reported from a smoke detector then the evacuation will be done initially by the local integral sounder. Then after a certain delay (to be agreed at the time of commissioning) the evacuation message shall be announced on that fire zone only. If after 3 minutes the alarm has not been acknowledged, the evacuation message shall also be announced on the other adjacent zones. All other zones shall be given the Alert message. The evacuation of the building shall be staged in phases to allow orderly movement of people.

B. If a Manual Break Glass Unit is activated or a sprinkler flow switch is operated, then the evacuation shall be transmitted immediately to the affected fire zone plus the adjacent zones.

C. Activation of the fire alarm system shall directly initiate some or all of the following to be agreed as a part of the overall engineering policy.

- Signal to all elevator machine rooms indicating fire status (to control lifts)
- Release doors normally locked by magnetic devices.
- Release doors normally held open by magnetic devices
- Shutdown mechanical equipment ventilation plant
- Shutdown general exhaust fans
- Start up smoke extract fans
- Start up exhaust make up fans
- Start up stair vestibule pressurization fans
- Automatically operate fire dampers
- Initiate alert signals to panels in the adjacent office tower.
- Sprinkler valves, flow switches and other monitored valves shall be directly supervised by the fire alarm systems.
  These shall include but not limited to the following:

- Building automation system via WINMAG OPC
- Emergency lighting system
- Security system.
SYSTEM COMPONENTS AND DEVICES

FIRE ALARM CONTROL PANEL:

A. The panel shall be modular Multifunctional computer controlled using 32 bit processor. Decentralised control and monitoring functions to be realised on the loop and spur. The panel shall be complete with, but not limited to, the following elements:

1) Visual display unit capable of displaying 8 lines 40 characters backlit display / ¼ VGA display as optional.
2) Built-in optional 40 character internal protocol thermal printer or external.
3) Built-in full numeric keyboard with function keys.
4) 64 Single Zone Indicator expandable upto 192 SZI
5) USB Port
6) Ethernet connection
7) SMART Card media slot.
8) Keyswitch to prevent unauthorised operation of keypad.
9) Integral sealed lead acid battery and charger, with 24 hour back up in the event of supply mains failure.
10) Essential controls – Delay, panel reset, Audible alarm off, Disconnect master box, additional messages, verify/cancel fault buzzer, Fire, Pre-Alarm, Trouble, Disconnection lamps. Each lamp shall also have appropriate indication (Releasing Systems activated, Master box, Delay, Verify, CPU failure, Inoperation normal condition & failure of powersupply / battery) Simple menu driven function keys with password protection shall allow users to an extensive range of software based features such as:

- Overview
- Service
- Time functions
- Informations
- Last 10000 system events
- Current fault and warning logs.
- Interrogation of sensor cleanliness
- On/Off, Enable/ disable sensors, zones, sounders, interface unit channels.
- Status of detectors
- Alarm counters
- Printer on, off, line feed and test facilities.

11) All control buttons and keyboard shall be enclosed behind a lockable cover, Up to 127 device capacity per 3.5km loop and a TTY/ RS 485 communication option.

12) In addition to the above, all other necessary controls, elements and accessories shall be included to provide a complete and efficient panel conforming to the requirements of DIN EN 54/UL.

13) LOOP PARAMETERS:

Individual loop circuits will be capable of accommodating the following.

- Up to a maximum of 127 addressable devices up to 3.5 kms loop length
- Up to 32 loop powered IQ8 Alarm addressable Sounders.
- Up to 32 loop powered IQ8 Alarm electronic Strobes.
- Up to 32 loop powered combined electronic sounders and strobes.
- Up to 80 sensors with integral alarm sounder.
- The detection loop shall have the ability to support both sensors and sounders connected on the same 2 core loop circuit.
- Up to 127 loop powered input modules.
- Should have the ability to spur off the detection loop without using ‘T’ breaker devices, without any degradation.

**CENTRAL GRAPHICS SUPERVISOR COMPUTER:**

The graphic visual display shall pictorially represent Fire, Fault and Emergency events on a visual display unit (VDU). The purpose of this facility shall be to provide the operator with the additional visual information over and above the text provided. All system events i.e. fire, fault and warning shall be automatically printed onto the graphics printer. Operation of the graphics terminal shall normally be by selection of the appropriate pages guided by a navigation system. However, it shall automatically track to the relevant initiating device for the first occurrence of each type of the event. The graphics terminal shall provide the following:

- DUAL LANGUAGE ENGLISH / ARABIC.
- Single Station version
- Multi Station Version
- Multi Networks
- Modem Interface
- Communications shall be bi-directional
- Free programming of alarm programs and alarm condition through SIA programming

Software shall have software interface using drivers with:

- Intruder Alarm Panels
- Fire Alarm Panels
- Video System
- Access Control System

Web Function: PC on Intranet/Internet using a common Web-browser shall be able to access the software with password.

Notification: Software shall be capable of transmitting text and voice messages to specific devices like cell phones, pagers etc.

Escalation: Software shall be capable of starting escalation action if within certain/configured time period the notification is not acknowledged.

Integration of IP telephony shall be possible at least with ALCATEL to have innovative linking of telephony via IQphone enabling the end-user devices to be used as multifunctional operating and display terminals with variable adaptation of applications.

HTML View: Applications such as Video streaming or BMS programs which have a Web server available shall be visualised clearly by Supervisor Software browser window USING Supervisor Interface.

Events display/status bar giving a clear and concise view of the current events on the fire alarm system, Intrusion CCTV or ACCESS control.
• Ability to control and change the following:
  • Disable actions
  • Labels & Auxiliary text
  • User Action buttons
  • Historic data of all the system events
  • Access levels/passwords to target specific levels of access to specific users
  • Graphical representation (if required) of the site allowing the exact location of the fire
    alarm events, e.g., fires, faults etc.
  • Panel remote buzzer cancellation
  • Event acknowledgement
  • Clock synchronization with panels with local adjustment facility
  • Touch screen support

The terminal shall assign a number of different graphic pages to each fire event – from a site overview of
building layout, through a floor layout, breaking the site down into increasing levels of detail. Number of
graphic pages required shall be finally determined by the client/consultant. For tender assume 4 pages per
floor, based on the drawings produced on AutoCAD by the Contractor.

The system shall operate on the Windows environment. The platform specification required is an IBM PC
compatible with the following minimum specifications.

  Pentium IV Processor, 1GHz speed
  256 MB RAM, 1 GB Hard Disk
  XGA-graphic card with min. 4 MB video memory
  Minimum 14 super VGA color screen
  Two serial ports and two parallel ports & Real time clock
  3.5 inch 1.44-MB floppy disk
  CD RW & Microsoft mouse

The combined text and graphics package shall be provided on the same supervisor. The supervisor with
touch screen is recommended.

SYSTEM EVENT PRINTER

A. The system printer shall be 40 character thermal printer optional in-built on the main control panel,
and shall log all events, change of status, alarm and fault messages along with time of the day and date.
An external 80 column dot matrix printer along with system PC is also recommended.

The printer shall provide the following:

- Hard copy of every event occurring
- Status read out of every addressable point
- Devices tested on a walk test
- Contaminated detectors needing replacement
- Single point scan printout of analogue values
- Hard copy of historic log.
FIELD DETECTION DEVICES

GENERAL: ANALOGUE DETECTORS & BASES

All analogue detectors and bases shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible.

All analogue detectors shall have real intelligence itself. This means even without control panel the detector can make decision, adapt to different environmental condition and diagnose itself. They shall have decentralized intelligence, automatic function self test, CPU failure mode, alarm and operating data memory and integrated short circuit line isolators. The detector bases for interfacing between the loop wiring and the detector head shall be manufactured by means of injection molded ABS plastic coloured white and shall not contain any electronics for addressing. The base fixings should be suitable for any industry standard BESA or conduit boxes. All bases shall include the option to provide a programmable relay output for interfacing, providing a dry contact for third party. All bases shall be provided with a plastic removable dust cover for protection during site construction as well as an IP rated sealing gasket to prevent dirt and moisture from entering through from the fixing surface. Each base shall include a lock and removal of locked detectors shall be achievable only through the use of the appropriate removal tools as specified by the manufacturer of the detectors. Detectors removal tools are to be handed over on completion of the contract as part of the spare parts to the client.

Removal of a detector from it’s associated base shall not affect the continuity of the detection loop.

The Fire alarm manufacturer shall have the complete range of following analogue

ADDRESSABLE detectors with decentralized intelligence as standard so as to meet the specific applications of the site.

a) Heat Detectors (fixed & ROR temperature)
b) Optical Smoke Detector
c) Optical Smoke & Heat Detector
d) Dual angle Optical/Heat Detector
e) Blue Light Optical / Heat Smoke Detector
f) Optical Smoke, Heat & CO gas Detector
g) Manual Call Points

All of the above shall be compatible with the aforementioned base providing interchangeability between detector heads, without the requirement for switch settings. All detectors shall also have an integral short circuit isolator, which in the event of a single cable fault will isolate the “culprit” piece of cable and retain all devices on the loop operationally.

Each detector shall possess two integral LED giving a red flashing indication for fire and green for normal operation. For remote locations, each detector shall be capable of connection to a remote LED unit by means of 2 core wire connection. Detectors shall be white in colour and manufactured from ABS plastic. All electronics and associated sensing elements will be housed within this unit, these components being hermetically sealed to prevent their operation from being impaired by dust, dirt and humidity. The sensitivity off all detectors shall be adjustable from a software. It shall be possible to programme detector sensor
sensitivity directly on the loop using interface with a laptop PC and appropriate programming software from manufacturer.

For MULTI SENSOR detectors, disablement of each sensor element shall be possible individually or for whole loop. Also this disablement feature shall be possible to have manually or time / event controlled.

All detectors shall be provided with a plastic removable dust cover for protection during site construction. A semi-flush recessing kit for analogue detectors shall be available for each detector type incorporating the standard detector base.

**HEAT DETECTORS**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 and shall be VdS /UL approved. This shall be a dedicated heat only detector to provide fixed temperature heat as well as rate of rise sensing. It should be fully compliant with EN54 part 5 to provide grades of A1.

**OPTICAL SMOKE DETECTOR:**

Install as shown in the drawings. Analogue Addressable Optical Smoke Detectors. These shall be of Automatic addressable Optical type with inbuilt isolator in a single head. The optical element shall detect visible smoke from slow smoldering fires. Smoke sensing design shall comply with EN 54 part 7 and shall be VdS/UL approved. It shall have microprocessors, short-circuit isolators and all electronic components and circuitry suitable for an Analogue addressable system. The detectors shall also have 360 degree viewing LED fire indicator. Detectors mounted in the false ceilings shall be provided with semi flush mounting kits.

**OPTICAL SMOKE /HEAT DETECTOR**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7 and shall be VdS/UL approved. These detectors shall have combined two individual sensing elements to provide excellent cover for both types of fires (slow smoldering & fast free burning fires). These detectors shall be of Automatic addressable Combined Optical/Heat type with inbuilt isolator in a single head.

Optical sensing shall be carried out by means of an Infra-red LED transmitting a pulse of light across an obtuse angled chamber & heat sensing shall be carried out by a thermistor, sampling the surrounding environmental temperature.

**DUAL ANGLE OPTICAL/HEAT DETECTOR**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7 and shall be VdS/UL approved. This device shall combine two individual sensing elements to provide excellent cover for both “types” of fires. (Slow shouldering and fast free burning). OPTICAL SENSING: Shall be carried out by 2 infra-red LED transmitters across 2 separate Optical detection angles. This sensor shall process both the forward and backward scattered Light caused by entering the detection chamber of device, allowing the detector to Differentiate between real smoke and non-smoke particles e.g. Steam & Dust.

HEAT SENSING: Shall be carried out by a thermistor, sampling the surrounding environmental temperature.
OPTICAL SMOKE / HEAT / CO DETECTOR

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7. The sensor element of the optical/heat detector with CO shall be as per the specification for the optical/heat detector. The CO element shall be incorporated into the optical chamber to sense the presence of carbon monoxide gas emissions from shouldering fires. In normal environments the CO element shall have a life expectancy of a minimum of 5 years.

MANUAL CALL POINTS

Install as shown in the drawings. The manual initiation devices shall be electrically compatible with all of the aforementioned detector types and shall be complete with all- electronic components and circuitry for an automatic safe addressable device. The manual call point shall have an inbuilt short circuit isolator and an inbuilt microprocessor to ensure a response time of less than 1 second.

The MCP unit shall also handle all communication to the control panel. All electronic devices contained within the MCP shall be hermetically sealed so as to prevent damage from hostile environment conditions: e.g dust with minimum rating of IP43.

The MCP operating voltage shall be 8-42 volts DC, RED similar to RAL 3020. If the MCP are located in public areas a transparent cover shall be provided as a protection tp prevent inadvertent activation. MCP shall be available in two designs Large & small for aesthetic purposes to architects.

The MCP shall have an input facility to connect conventional devices. It should have an option of using either frangible glass allowing for complete removal upon operation or plastic pane resettable function. There shall be no text but SYMBOLS on the MCP ( burning house / press to break ).

The device can be tested functionally without the need to either remove the front cover and/or breaking the glass, with a special test key (supplied as standard). The key shall insert the underside of the MCP ensuring easy access of the key at all times.

These devices will comply fully with EN 54 part 1.

FIELD ALARM DEVICES

Electronic sounders, combined sounder/strobe and standalone strobes shall be loop

Powered for direct connection to the 2 core detection loop shall be electrically compatible with all initiation devices. These wall mounted units shall be available in red or white and suitable for both indoor and outdoor applications with an ingress protection rating of IP31 and IP65 respectively.

All electronic sounders, sounder/strobe and strobe only versions shall have alarm signals synchronized across all the detection loops of the fire alarm control panel. All alarm devices shall have a short circuit isolation device provided as an integral component of the device.

All sounders shall have a ‘soft start’ feature controlled by the fire alarm panel, whereby a low initial volume can be set and then increased at a defined rate upto a maximum volume setting.

All alarm devices shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible. The Fire alarm manufacturer shall have the complete range of following alarm devices with built in short circuit line isolators so as to meet the specific applications of the site.
a) Addressable Sounder
b) Addressable Flasher
c) Addressable Sounder / Flasher
d) Addressable Speech Sounder
e) Addressable Sounder / Flasher / Speech

ADDRESSABLE ALARM SOUNDER

Alarm sounders shall be capable of providing a minimum sound level of 97dBA ± 2dBA @ 1 meter.

The sounder shall be capable of providing 4 different sound signals, which are selected/configured from 19 tone types stored in the device.

Each sounder shall include its own microprocessor to handle loop communications and monitoring of the internal sound element during an alarm condition. This shall allow faulty devices to be automatically identified during the weekly test procedure. All associated electronic components shall be hermetically sealed to provide protection from hostile operating environments.

It shall be possible to connect up to 32 Addressable Alarm sounders to each detection loop of the fire alarm control panel. These devices will comply fully with EN 54 part 3.

FIELD INTERFACE TRANSPONDERS

These devices shall be directly connected to the loop, four variants shall be available as standard, these being:

(i) 4 In / 2 Out interface unit
(ii) 1 In interface unit
(iii) 32 LED output interface unit
(iv) 12 Relay output Interface unit.

These units shall be self-contained wall mountable units, similar in finish to the main control panel.

(i) 4 In / 2 Out interface unit

Interface units shall be capable of accepting 4 input signals, 2 output signals. Dependent upon the specific application, input signals may be interpreted by the system as any of the following:

- Fire signal input
- Fault signal input
- Supervisory signal input
- Event signal input

The exact nature of which shall be selected by means of the commissioning software. These units will accept and or supply clean contact signals either normally open or normally closed (configurable) OR switched voltage inputs from conventional detectors or MCP’s.

The output contacts shall be rated at 30V / 1 amp. DC output of the unit shall be provided with single pole change over contacts for control of plant, door release units or power output to drive conventional bells, sounders etc. Both the outputs on the interface shall be individually programmable. External power supply 12V / 24 VDC shall be provided to this unit.
As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications. Product shall be approved by VdS.

(ii) **1in interface unit**

Interface units shall be capable of accepting 1 input signal. Dependent upon the specific application, input signals may be interpreted by the system as any of the following:

- Fire signal input
- Fault signal input
- Supervisory signal input
- Event signal input

The exact nature of which shall be selected by means of the commissioning software.

These units will accept and or supply clean contact signals only, either normally open or normally closed (configurable). No switched voltage inputs or outputs will be accepted.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications.

(iii) **32-LED output interface units**

These interface units contain 32 outputs for triggering LEDs of e.g. mimic panels. Each output can be freely programmed with the commissioning software. The outputs are selectable as positive or negative signals. There shall be possibility to test the outputs/LEDs manually with e.g. a button.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications.

(iv) **12-Relay output interface units**

These interface units contain 12 clean relays which are individually programmable with the commissioning software. All relays can be configured as NO or NC.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications.

**NETWORKING OF CONTROL PANELS**

It shall be possible to network connect up to 31 controls as a secure network connection. All messages from a panel should be transmitted in both direction on the ring structure. Any wire-break or short-circuit on the ring shall not effect data transmission. The network shall be configurable so that single panels, groups of panels or all panels on the network operate the same site configured cause and effect fire plan.

The network shall also be configured to allow master control from any one of the control panels on the network. To cover longer distance repeaters or fibre optical cable and converters can be used between two panels.

The network shall be able to accommodate intruder alarm panels.

There shall be extensive diagnostic functions on the panel to be used to localise faults caused by interference or wiring. Networking shall be capable of carrying out using a datacable e.g IBM type 1 or CAT5. The distance between each panel shall be standard 1200 meters and capable of extending upto 3000 meters using booster repeaters.
NETWORKED LCD OPERATING PANELS / REPEATER PANELS

The Repeat Panel shall be sited at the Rear Entrance, guard house or location where it is manned 24 hrs. It shall provide system repeat facilities to repeat all of the liquid crystal display messages as well as the common indications. Repeat panel shall be interfaced for network fire alarm control panels, designed for standardised display and operation as per DIN EN 54 part 2 and DIN VDE 0833 part 2. Installation and connection to FACP shall be via the short circuit and open circuit resistant essernet. System network. RS 485 interface or TTY interface for connecting remote printers, and fire brigade shall be available. The repeaters shall have minimum three common relays freely programmable, monitored, potentiola free upto 24 VDC.

BATTERIES:

Batteries shall be provided and shall be the dry sealed lead-acid type. The batteries shall have ample capacity. With primary power disconnected, to operate the fire alarm system for a period of 24 hours with an optional 72 hours battery backup. Following this period of operation via batteries. The batteries shall have ample capacity to operate all components of the system, including all alarm signalling devices in the total alarm mode for a minimum period of 30 minutes.

WIRING

All cables associated with Fire Alarm installation shall be of fire resistant 2 core 1.5 sq. mm twisted pair. Cables shall comply with BS 6207 Part 1. The cable is to BS 6207: Part 1 having, Typically no more than 2 cores each having 1.5 sq. mm cross sectional area, A red cover sheath (preferred for alarm applications), Having continuous metal sheath encapsulation, Fire resistant tested to BS6387 categories CWZ.

INSTALLATIONS

The entire fire alarm system shall be installed in accordance with DIN / BS EN54 /NFPA Standards and manufacturer’s approved shop drawings, written instructions and recommendations.

TESTING

Fire alarm system shall be tested in accordance to Local Civil Defence regulations and put into operation by the manufacturer or his authorized representative in the presence of engineer. Fault and alarm conditions shall be simulated and all data and alarm indicators checked with full events recorded on system printer according to the testing procedure.

PUBLIC ADDRESS SYSTEM STANDARDS International:

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

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

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

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

GENERAL DESCRIPTION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A 100 Mbit Ethernet LAN, also for proprietary use, serves as a means of transmitting signals.

It must be possible to design a redundant network by means of external modules.

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

Amplifiers must have symmetrically audio inputs.
The VA/PA system must fulfill the following requirements:

- Fully digital network-capable system with graphical user interface. Operating software for remote control and diagnosis of all systems states. Software for optional setup (configuration) of functions, modes and properties of system components, devices and controls including the connection of loudspeaker lines to public address areas, and the corresponding allocation of a selection key at the system digital call station; The user can modify the configuration using any client with an easy-to-understand, menu-driven user interface. Up to 120 simultaneous audio channels must be available over the network with an available bandwidth of 100Mbit/s effective.

- Continuous, inaudible monitoring of all signal paths
- All errors must be detected, displayed, and recorded (log view) within a matter of seconds.
- Ability to easily program digital call stations for selective, group and collective calls (e.g. 1 fire control PA panel, 3 information call stations, more possible at any time).
- Continuous monitoring of power amplifiers with integrated noise detection and inaudible tone. If a power amplifier should fail, a backup amplifier will automatically and immediately replace the power amplifier in question.
- Double pole connection of 100 V loudspeaker modulation;
- Continuous processor - controlled line monitoring of all loudspeaker lines for short circuits, idling, ground faults and impedance value errors, independent of activated announcements. Monitoring must not be audible. Save error messages with the option for subsequent display; save set points of line parameters; Set up and interrogate system with easy-to-understand, menu-driven software. Non-reactive disconnection of loudspeaker circuits detected to be faulty without any consequence to any other speaker lines.
- To ensure continuous operation, the gooseneck microphone for the digital call station must be acoustically monitored. Similarly, the malfunction of any button, component, cable, or any logical connection must be monitored and sent to the operating unit immediately via the LAN. The signal is transmitted between the digital call station and the central control unit in AHO/EBU digital audio format.
- Intercom function between digital call stations.
- To adjust the volume in public address areas with constantly changing noise levels, an automatic volume control must always be available in real time, independent of the ambient noise level. This function is activated using software tools from the appropriate central output modules for this area.
- Digital storage and playback of at least 16 different alarm signals and texts for 260 seconds in non-volatile memory.
- Input of external signal sources (independent programs/background music) in the VA/PA system via separate input modules and via NF inputs in the system digital call stations.
- Connection to a fire alarm system
  The planning and invitation to tender are based on Honeywell's VARIODYN D1 model. Equivalence must be ensured in the case of alternate offers as these are based on customer-specific assessments of requirements.

Special performance features

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

Performance features with YHO/NO

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

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

Digital signal processing (DSP) 

- Per DAL bus audio stream 

* Adjustable volume 

* Configurable limiter for the digital call station microphone (DCS, DCSF). 

- Per Amplifier channel 

* Adjustable volume 

* Automatic volume control (AVC) 

* High-pass filter 2, 4, 6 sequence (cutoff frequency: 20 Hz - 20 kHz) 

* Low-pass filter 2, 4, 6 sequence (cutoff frequency: 20Hz - 20kHz) 

* Delay (0-2.000 msec) 

* Parametric equalizer, 8 bands 

- Level indicator for audio inputs and outputs. 

Audio memory/signals 

- Audio memory for critical alarms such as evacuation announcements in accordance with IEC EN 60849 on non-volatile flash memory. 16 memory places for 260 sec in total are available. E.g. for pre recorded audio signals (gongs, signals, texts, etc.) for example in accordance with DIN 33404 and KTA 3901, in each digital audio distribution and connection system (maximum 24 Loudspeaker lines each) 

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

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

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

- Connection time limit 

- Activation type – press/toggle 

- Individual volume 

- With/without automatic volume control 

- Multisource; an audio source can be used by several connections simultaneously. 

- Priority (1-250) 

- Recording the activation or deactivation of the connection. 

- Saving the announcement
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- Partial connection
- Timeout
- Warning signal, e.g. an attention signal such a gong
- Reconnection
- Repetition

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

**Remote control, remote maintenance**
- The system can be remotely maintained via an open data protocol.

Building management systems, path control machines, or airline passenger information systems, for example, can set any individual announcements and obtain status information from the system.

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

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

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

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

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

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

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

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

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

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

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

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

**Power management**
- Primary power supply: 230 V AC
- Secondary power supply (emergency power): 24 V DC
- Less important announcements (e.g. background music) can be switched off when there is an outage in the primary power supply (230V AC).
Control inputs & control outputs
- Keys with associated LEDs or contacts
- Any allocation of control inputs and control outputs for functions, e.g. for triggering priority relays for 100V volume controllers.

Monitoring
- Monitoring of connection from digital call station to VA/PA system.
- Acoustic monitoring of digital call station microphone or hand microphone (fire control PA panel).
- Acoustic monitoring of amplifier channel.
- Monitoring of loudspeaker line for short circuits, interruptions and impedance changes via impedance measurement – independent of connections.

The thresholds for short circuits, open lines, and ground faults can be customized.
- Monitoring of loudspeaker line for short circuits or interruptions by means of EOL (end of line module) – independent of connections.
- Monitoring of loudspeaker line for ground faults.

Independent of circuit-entering loudspeaker lines:
- Monitoring of the communication of several VA/PA systems on the network.
- Lamp tests/contact tests via button or contact.
- Error in data interface to fire panels (e.g. Honeywell, Notifier)
- Failure in primary and secondary power supply (emergency power)

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

Networking
- Up to 250 digital audio distribution and connection systems on a network.
- Networking via 10, 100 Mbit(recommended) or Gbit Ethernet.
- Transmission of various audio data is only restricted by the transmission bandwidth.
- Up to 120 audio data channels on a 100 Mbit network.
- Up to 16 different audio channels items per digital audio distribution and connection systems can be processed simultaneously over the network.
- SNMP (Simple Network Management Protocol) to monitor network elements from a central station.
- Specified delay of local destination for a connection to offset the latency period of the network destinations.
- VLAN ID can be adjusted for integration in existing network structures, e.g. taking into account other network systems such as CCTV, etc.
**Timer programs**
- Time-controlled connection for bell systems, e.g. in schools.
- Time-based volume control for all audio inputs/outputs, e.g. reduced volume at tram stops at night-time.
- Time-controlled activation/deactivation of monitoring of loudspeaker lines.
- Time-controlled actuation/deactivation of amplifier channels monitoring.

**Time synchronization**
- The individual devices are synchronized. Master/Slave configuration possible.
- External time synchronization via NTP (Network Time Protocol) possible.
- External time synchronization via GPS possible.
- Automatic adjustment for daylight saving changes.

**Destination – Group formation**
- Any circuits (destinations) can be grouped together in pre-selection points.
- Circuits can be grouped in any nested format.

**Temporary storage of an announcement (automatic)**
- Announcements can automatically saved and played back within a user-defined timeout period when the required points are released.
- Status display and control options via buttons and control contacts.

**Temporary storage of an announcement (manual)**
- Record, listen and playback possible.

**Audio matrix**
- Any input can be route to any output without any restrictions
  - Input can be a call station, analog audio input, and audio memory
  - Output can be a loudspeaker line, call station and analog audio output

**Performance features with value indication**
- Max. number of addressable audio inputs: 2,000
- Max. number of audio data items that can be transmitted simultaneously via 100 Mbit Ethernet: 120
- Max. number of addressable amplifier channels: 1,000
- Max. number of addressable loudspeaker circuits: 6,000

**Interfaces**

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

Interface: RS232

Data rate: 19,200 bps

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

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

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

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

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

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

**Products**

**System components**

**Digital audio distribution and connection system for up to 8 loudspeaker zones**
Module with audio signal processing for connecting and controlling power amplifiers and for connecting loudspeaker circuits.
Four independent audio outputs for connecting power amplifiers (up to 500 Watt per channel) and for simultaneous processing of up to four different audio information items per module.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Emergency 24 V power supply as secondary power supply.

Display

4 LEDs for device operating state:
in operation, warning/error, emergency control option, power-saving mode

8 LEDs for indicating the control contacts state

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

8 error and 8 loudspeaker circuit relay LEDs

Operating elements

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

1 monitoring loudspeaker

<table>
<thead>
<tr>
<th>Audio output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output type</td>
<td></td>
</tr>
<tr>
<td>Nominal level</td>
<td>0 dBu</td>
</tr>
<tr>
<td>Max. output level</td>
<td>+6 dBu</td>
</tr>
<tr>
<td>Frequency range</td>
<td>20 Hz to 20 kHz</td>
</tr>
<tr>
<td>Max. deviation from linear frequency</td>
<td>± 1 dB in frequency range</td>
</tr>
<tr>
<td>Distortion factor at nominal level</td>
<td>&lt; 0.03% at 1 kHz</td>
</tr>
<tr>
<td>Max. distortion factor</td>
<td>0.1% in frequency range</td>
</tr>
<tr>
<td>Signal-to-noise ratio at nominal level</td>
<td>&gt; 75 dB (A)</td>
</tr>
<tr>
<td>Load impedance</td>
<td>min. 5 kΩ, max. 500 pF</td>
</tr>
</tbody>
</table>

| Sensor input (AVC*)          |         |
| Input type                   |         |
| Nominal level                | -51 dBu |
| Nominal level for emergency call station | 0 dBu |
| Frequency range              | 100 Hz to 8 kHz |
| Max. deviation from linear frequency | ± 6 dB in frequency range |
| Distortion factor at nominal level | < 0.2% at 1 kHz |
| Max. distortion factor       | 1% in frequency range |
| Signal-to-noise ratio at nominal level | > 65 dB (A) |
| Input impedance              | typ. 200 Ohm |

| Control contacts             |         |
| Max. voltage                 | 100 V DC/1 A |
| Impulse withstand voltage    | > 2.5 kV |

| Pass-through contacts        |         |
| Max. voltage                 | 250 V AC, 30 V DC/5 A |
| Impulse withstand voltage    | > 1.5 kV |

| Power supply                 |         |
| Rated voltage                | 90 V AC to 264 V AC |
| Nominal frequency            | 47 Hz to 440 Hz |
| Power rating with/without 4x DAL | 4 W/70 W at 230 V AC |
| Emergency power supply       |         |
| Voltage range                | 21.6 V DC to 30 V DC |

| Ambient temperature range    | -5°C to +55°C |
| Relative humidity            | 15% to 90%  |
*AVC = Automatic Volume Control

**Digital audio distribution and connection system for up to 24 loudspeaker zones**
Module with audio signal processing for connecting and controlling power amplifiers and for connecting loudspeaker circuits.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Emergency 24 V power supply as secondary power supply.
Display

4 LEDs for device operating state:

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

8 LEDs for indicating the control contacts state

4 LEDs for indicating the state of each connected power amplifier

24 error and 24 loudspeaker circuit relay LEDs

Operating elements

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

1 monitoring loudspeaker

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

Sensor input (AVC*)

| Input type | symmetrical, non-earthed |
| Nominal level | -51 dBu |
| Nominal level for emergency call station | 0 dBu |
| Frequency range | 100 Hz to 8 kHz |
| Max. deviation from linear frequency | ± 6 dB in frequency range |
| Distortion factor at nominal level | < 0.2% at 1 kHz |
| Max. distortion factor | 1% in frequency range |
| Signal-to-noise ratio at nominal level | > 65 dB (A) |
| Input impedance | typ. 200 Ohm |

Control contacts

| Max. voltage | 100 V DC/1 A |
| Impulse withstand voltage | > 2.5 kV |

Pass-through contacts

| Max. voltage | 250 V AC, 30 V DC/5 A |
| Impulse withstand voltage | > 1.5 kV |

Power supply

| Rated voltage | 90 V AC to 264 V AC |
| Nominal frequency | 47 Hz to 440 Hz |
| Power rating with/without 4x DAL | 50 W/80 W at 230 V AC |
| Emergency power supply |  |
Voltage range 21.6 V DC to 30 V DC
Ambient temperature range -5°C to +55°C
Relative humidity 15% to 90%

*AVC = Automatic Volume Control

**System communication unit**
The system communication unit acts as a digital audio memory for the VA/PA system.

This allows more than 50 channels of audio data to be recorded and played back at the same time – regardless of the available bandwidth from the network.

The connection to a VA/PA system network is established via Ethernet and is monitored continuously.

As per IEC EN 60849, the audio data for critical alarms and evacuation messages is stored on non-volatile flash memory. The memory capacity is approximately 2 hours.

Additional messages, such as announcements, signals or advertising texts, are stored on a hard drive. The memory capacity is approximately 1,000 hours.

The component can also be used for logging and recording announcements. These are stored on the hard disk and saved with the date, time and trigger information.

Including a call stacker function which allows to stored announcements temporarily and played them back simultaneously and automatically within a particular time limit when the desired point is released.

**24 V DC emergency power supply as secondary power supply.**

| Audio capacity flash memory | approx. 2 hours. |
| Audio capacity hard drive   | approx. 1,000 hours. |

**Power supply**
Nominal voltage 90 V AC to 264 V AC
Nominal frequency 47 Hz to 63 Hz
Nominal current typ. 0.5 A @ 230 V AC
Emergency power supply
Voltage range 21.6 V DC to 30 V DC
Ambient temperature range -5°C to +55°C
Relative humidity 15% to 90%

**Digital call station with 12 keys**
Fully digital call station with electret microphone (cardioids characteristic) on a flexible 300 mm long gooseneck.

Integrated broadband loudspeaker for monitoring and previewing purposes as well as intercom functions.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

12 freely programmable buttons, which can be labeled.

13 integrated and 12 freely programmable LED display elements including a combined operation and error display.
Digital transmission of control signals and all four audio signals to and from the digital call station and the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5E cable (shielded) and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

RJ12 socket for connection with up to 6 expansion modules via daisy chain.

An audio input with 2 cinch sockets at the back of the digital call station for connecting an auxiliary device allows audio playback outside of the central control unit.

An audio output can be used for monitoring purposes or for audio distribution or recording.

In- and output are independent from the microphone and can be used simultaneously.

A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone</td>
<td>electrets, cardioids characteristic</td>
</tr>
<tr>
<td>Gooseneck</td>
<td>300 mm</td>
</tr>
<tr>
<td>Frequency range</td>
<td>100-15,000 Hz</td>
</tr>
<tr>
<td>Loudspeaker - power</td>
<td>1 W</td>
</tr>
<tr>
<td>Audio input</td>
<td></td>
</tr>
<tr>
<td>Nominal level</td>
<td>0 dBu</td>
</tr>
<tr>
<td>Max. level</td>
<td>+6 dBu</td>
</tr>
<tr>
<td>Frequency range</td>
<td>20 Hz to 22 kHz</td>
</tr>
<tr>
<td>Signal-to-noise ratio</td>
<td>&gt; 95 dB</td>
</tr>
<tr>
<td>Distortion factor (at nominal level)</td>
<td>&lt; 0.1 %</td>
</tr>
<tr>
<td>Audio output</td>
<td></td>
</tr>
<tr>
<td>Nominal level</td>
<td>0 dBu</td>
</tr>
<tr>
<td>Frequency range</td>
<td>20 Hz to 22 kHz</td>
</tr>
<tr>
<td>Signal-to-noise ratio</td>
<td>&gt; 85 dB</td>
</tr>
<tr>
<td>Distortion factor (at nominal level)</td>
<td>&lt; 0.1 %</td>
</tr>
<tr>
<td>Output impedance</td>
<td>180 Ohm</td>
</tr>
<tr>
<td>Sample rate</td>
<td>48 kHz</td>
</tr>
<tr>
<td>AD/DA converter</td>
<td>24 Bit</td>
</tr>
<tr>
<td>Max. power consumption</td>
<td>150 mA</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>-5 °C to +55 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>15% to 90%</td>
</tr>
</tbody>
</table>

**Digital call station with one key**

Fully digital call station with electret microphone (cardioid characteristic) on a flexible 300 mm long gooseneck.

Integrated broadband loudspeaker for monitoring and previewing purposes as well as intercom functions.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

A freely programmable button, which can be labeled.

Two integrated and one freely programmable LED display elements including a combined operation and error display.
Digital transmission of control signals and all four audio signals to and from the digital call station and the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

RJ12 socket for connection with up to 6 expansion modules via daisy chain.

A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

<table>
<thead>
<tr>
<th>Microphone</th>
<th>electret, cardioid characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gooseneck</td>
<td>300 mm</td>
</tr>
<tr>
<td>Frequency</td>
<td>100-15,000 Hz</td>
</tr>
<tr>
<td>Loudspeaker- power</td>
<td>1 W</td>
</tr>
</tbody>
</table>

Sample rate | 48 kHz
AD/DA converter | 24 Bit
Max. power consumption | 150 mA

Ambient temperature range | -5 °C to +55 °C
Relative humidity | 15% to 90%

**Fire Control PA Panel with 12 keys**

Fully digital call station with handheld microphone and built-in loudspeaker for monitoring and previewing purposes and intercom functions in integrated housing.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

12 freely programmable buttons, which can be labeled.

12 integrated and freely programmable LED display elements including a combined operation and error display.

Digital transmission of control signals and all audio signals to and from the digital call station and to the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

RJ12 socket for connection with up to 6 expansion modules via daisy chain.

A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

<table>
<thead>
<tr>
<th>Microphone</th>
<th>Handheld microphone, cardioid characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>200-12,500 Hz</td>
</tr>
<tr>
<td>Loudspeaker- power</td>
<td>1 W</td>
</tr>
<tr>
<td>Sample rate</td>
<td>48 kHz</td>
</tr>
<tr>
<td>AD/DA converter</td>
<td>24 Bit</td>
</tr>
<tr>
<td>Max. power consumption</td>
<td>150 mA</td>
</tr>
</tbody>
</table>

Ambient temperature range | -5 °C to +55 °C
Relative humidity | 15% to 90%
Fire Control PA Panel with one key
Fully digital call station with handheld microphone and built-in loudspeaker for monitoring and previewing purposes and intercom functions in integrated housing.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

A freely programmable button, which can be labeled.

Two integrated and one freely programmable LED display elements including a combined operation and error display.

Digital transmission of control signals and all audio signals to and from the digital call station and to the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).

Optional fiber optic connection for distances up to 2,000 meters.

RJ12 socket for connection with up to 6 expansion modules via daisy chain.

A 3 m long CAT5 standard connection cable for copper cabling is included as standard.

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</tr>
<tr>
<td>Loudspeaker - power</td>
<td>1 W</td>
</tr>
<tr>
<td>Sample rate</td>
<td>48 kHz</td>
</tr>
<tr>
<td>AD/DA converter</td>
<td>24 Bit</td>
</tr>
<tr>
<td>Max. power consumption</td>
<td>150 mA</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>-5 °C to +55 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>15% to 90%</td>
</tr>
</tbody>
</table>

Digital fire control PA panel
Fully digital call station with handheld microphone and built-in loudspeaker for monitoring and previewing purposes and intercom functions in surface-mounted or flush-mounted housing.

Continuous acoustic monitoring of microphone capsule. Acoustic monitoring is not only used to check the functioning of the voice coil but also of the capsule.

Five freely programmable buttons for the alarm

One button for the all-clear signal

One button for reset/acoustic

Three integrated LED display elements (in operation, fault, busy)

Digital transmission of control signals and all audio signals to and from the digital call station and the supply voltage via DAL link.

The digital call station is connected to the VA/PA system in star-shaped topology via CAT 5 cable and RJ45 socket (up to 300 meters distance).
Optional fiber optic connection for distances up to 2,000 meters.

Display window and locking mechanism in accordance with EN 54-11.

Conforms to the Austrian F 3033 standards and must be verified by a positive test protocol carried out by an accredited body.

<table>
<thead>
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<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>Sample rate</td>
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</tr>
<tr>
<td>AD/DA converter</td>
<td>24 Bit</td>
</tr>
<tr>
<td>Max. power consumption</td>
<td>150 mA</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>-5 °C to +55 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>15% to 90%</td>
</tr>
<tr>
<td>Color</td>
<td>Red RAL 3000</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 2.0 kg</td>
</tr>
<tr>
<td>Dimensions (H x W x D)</td>
<td>300 x 200 x 30 mm</td>
</tr>
</tbody>
</table>

**Digital Keyboard Module**

Digital keyboard module for digital call stations

Allows an extension of 18 extra freely programmable keys that can be labeled as well as 18 LED display elements.

Digital transmission of control signals to the digital call station.

The keyboard module is supplied with 24 V DC by the digital call station.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature range</td>
<td>-5 °C to +55 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>15% to 90%</td>
</tr>
</tbody>
</table>

**Universal Interface Module**

Interface module for connecting two analog audio inputs, two analog audio outputs, and 48 control contacts.

The two audio inputs are both asymmetrical (RCA) and symmetrical (XLR-f).

The two audio outputs are both asymmetrical (RCA) and symmetrical (XLR-m).

The 48 control contacts can be set via software configurations in any combination as potential input contacts and/or output contacts; eight can be monitored.

Digital transmission of control signals and all audio signals to and from the VA/PA system and the supply voltage via DAL link.

Display

A green POWER LED

A yellow ERROR LED

4 green SIGNAL LEDs for signaling potential audio modulation.
Audio inputs

Nominal level 0 dBu
Max. level +6 dBu
Frequency range 20 Hz to 22 kHz
Signal-to-noise ratio > 95 dB
Distortion factor (at nominal level) < 0.05 %
Input impedance XLR socket 100 kΩ, symmetrical, potential-free
Output impedance CINCH socket 1 kΩ, asymmetrical, potential-free

Audio outputs

Nominal level 0 dBu
Frequency range 20 Hz to 22 kHz
Signal-to-noise ratio > 85 dB
Distortion factor (at nominal level) < 0.05 %
Output impedance XLR socket 200 Ω, symmetrical, potential-free
Output impedance CINCH socket 200 Ω, asymmetrical, potential-free

Control contacts
Input contact
Max. input voltage +36 V DC
Output contact
Contact rating 36 V DC/50 mA
Short-circuit proof for +24V 1 s
Ambient temperature range -5 °C to +55 °C
Relative humidity 15% to 90%

Contact Interface Module

Interface module for connecting eight control contacts.

The eight control contacts can be set via software configurations in any combination as potential input contacts and/or output contacts; four can be monitored.

Digital transmission of control signals and the supply voltage via TWI (two-wire interface).

Control contacts
Input contact
Max. input voltage +36 V DC
Output contact
Contact rating 36 V DC/50 mA
Short-circuit proof for +24V 1 s
Ambient temperature range -5 °C to +55 °C
Relative humidity 15% to 90%

Power amplifier 2 x 250 W/100 V; class D, 24 V DC

Highly efficient class D power amplifier.

The power amplifier includes the following characteristics:
- Complies with IEC BS EN 60268-3, 55013, and 55020 standards
- Self-monitoring and self-testing via microcontrollers
- Protected against overload, short circuits and over-heating
- Built-in fan with temperature-controlled rotation speed control, with airflow from front to back of device
- Monitoring of the fan’s self, if one is failed – the left fan must set on 100% speed automatically.
- LED status display per channel for POWER, SIGNAL, CLIP, and ERROR
- LED status display for MAINS POWER; BATT POWER, CPU STATUS, SYS FAULT
- Emergency power supply via 24 V DC
- Symmetrical audio inputs and control via CAT 5 cable with RJ45 connector
- 100 V outputs via pre-assembled system cable, lockable

<table>
<thead>
<tr>
<th>Technology</th>
<th>Class D, 100 V outputs with transformers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output power (at 230 V mains supply)</td>
<td>250 W with 40 Ω load</td>
</tr>
<tr>
<td>Output power (at 24 V DC emergency power supply)</td>
<td>250 W with 40 Ω load</td>
</tr>
<tr>
<td>Mains supply</td>
<td>230 V AC 50/60Hz +10% to -15%</td>
</tr>
<tr>
<td>Emergency power supply</td>
<td>21.5 V DC to 28.5 V DC</td>
</tr>
<tr>
<td>Frequency response</td>
<td>50 Hz to 22 kHz ± 3dB</td>
</tr>
<tr>
<td>Distortion factor</td>
<td>&lt; 0.3% at 1 kHz sine</td>
</tr>
<tr>
<td>Signal-to-noise ratio</td>
<td>90 dB (A-weighted)</td>
</tr>
<tr>
<td>Channel separation</td>
<td>&gt; 75 dB</td>
</tr>
<tr>
<td>Efficiency at maximum power</td>
<td>&gt; 80%</td>
</tr>
<tr>
<td>Color</td>
<td>RAL 7016</td>
</tr>
<tr>
<td>Ambient temperature range</td>
<td>-5 °C to +55 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>up to 90 % (non-condensing)</td>
</tr>
</tbody>
</table>

**Power amplifier 2 x 400 W/100 V; class D, 24 V DC**
Highly efficient class D power amplifier.

The power amplifier includes the following characteristics:
- Complies with IEC BS EN 60268-3, 55013, and 55020 standards
- Self-monitoring and self-testing via microcontrollers
- Protected against overload, short circuits and over-heating
- Built-infan with temperature-controlled rotation speed control, with airflow from front to back of device
- Monitoring of the fan’s self, if one is failed – the left fan must set on 100% speed automatically.
- LED status display per channel for POWER, SIGNAL, CLIP, and ERROR
- LED status display for MAINS POWER; BATT POWER, CPU STATUS, SYS FAULT
- Emergency power supply via 24 V DC
- Symmetrical audio inputs and control via CAT 5 cable with RJ45 connector
- 100 V outputs via pre-assembled system cable, lockable
Technology Class D, 100 V outputs with transformers
Output power (at 230 V mains supply) 400 W with 25 Ω load
Output power (at 24 V DC emergency power supply) 400 W with 25 Ω load
Mains supply 230 V AC 50/60Hz +10% to -15%
Emergency power supply 21.5 V DC to 28.5 V DC
Frequency response 50 Hz to 22 kHz ± 3dB
Distortion factor < 0.3% at 1 kHz sine
Signal-to-noise ratio 90 dB (A-weighted)
Channel separation > 75 dB
Efficiency at maximum power > 80%
Color RAL 7016
Ambient temperature range -5 °C to +55 °C
Relative humidity up to 90 % (non-condensing)

Loudspeaker Ceiling Loudspeaker

<table>
<thead>
<tr>
<th>Specifications</th>
<th>SS-CL06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speakers</td>
<td>5&quot;</td>
</tr>
<tr>
<td>Rated Power</td>
<td>6 W</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>1.7nK</td>
</tr>
<tr>
<td>Power taps @70V</td>
<td>3 W</td>
</tr>
<tr>
<td>Power taps @100V</td>
<td>6 W</td>
</tr>
<tr>
<td>SPL 1W / 1m</td>
<td>88 dB</td>
</tr>
<tr>
<td>SPL 1M / W max</td>
<td>95.8 dB</td>
</tr>
<tr>
<td>Frequency response(effective)</td>
<td>85 Hz~20 KHz</td>
</tr>
<tr>
<td>Dispersion angle</td>
<td>160</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Ø180 × 55 mm</td>
</tr>
<tr>
<td>Hole cut-out size</td>
<td>Ø150 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>0.68 Kg</td>
</tr>
<tr>
<td>Material</td>
<td>Metal</td>
</tr>
<tr>
<td>Color</td>
<td>Similar RAL9010</td>
</tr>
</tbody>
</table>
Wall Mount Loudspeaker

<table>
<thead>
<tr>
<th>Specifications</th>
<th>SS.WM06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speakers</td>
<td>4&quot;</td>
</tr>
<tr>
<td>Rated Power</td>
<td>3 W</td>
</tr>
<tr>
<td></td>
<td>6 W</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>3.3 Kohm</td>
</tr>
<tr>
<td></td>
<td>1.7 Kohm</td>
</tr>
<tr>
<td>Power taps @70V</td>
<td>1.5 W</td>
</tr>
<tr>
<td></td>
<td>3 W</td>
</tr>
<tr>
<td>Power taps @100V</td>
<td>3 W</td>
</tr>
<tr>
<td></td>
<td>6 W</td>
</tr>
<tr>
<td>SPL1W \ 1m</td>
<td>104.6 dB</td>
</tr>
<tr>
<td>SPL1M \ W max</td>
<td>96.8 dB</td>
</tr>
<tr>
<td>Frequency response(effective)</td>
<td>160 Hz–20 KHz</td>
</tr>
<tr>
<td>Dispersion angle</td>
<td>150</td>
</tr>
<tr>
<td>Dimensions</td>
<td>260 × 180 × 120 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>1.08 Kg</td>
</tr>
<tr>
<td>Material</td>
<td>ABS</td>
</tr>
<tr>
<td>Color</td>
<td>Similar RAL9010</td>
</tr>
</tbody>
</table>

UPS SYSTEM-

SYSTEM COMPONENTS

PWM IGBT with high frequency (25 KHz or more) or better Technology.

POWER

On-Line UPS with upgradability minimum 50% (specify the limit, process and cost implication for expanding the power rating).

PRODUCT CERTIFICATION/TESTING

The product shall have certification from any one of the following -

a) ERTL
b) ETDC
C) STQC
d) IEC
e) ISO 9001

OPERATING TEMPERATURE
0-40 degree Centigrade

**HUMIDITY**

Upto 95%

**OUTPUT FREQUENCY**

50 Hz +/- 0.01% Hz

**WAVE FORM**

Pure Sine Wave

**TRANSIENT RESPONSE**

+/- 1% maximum under following conditions:

a) Loss or Return of Input AC supply

b) 100% step load

**RECOVERY TIME**

To nominal voltage in less than 10 milli second.

**EFFICIENCY (OVER ALL )**

Minimum 95% at full load.

**LOAD POWER FACTOR**

0.8 lag to unity.

**CREST FACTOR**

Greater than 3:1

**MTBF**

Minimum 100000 hrs.

**SWITCH OVER TIME**

Zero
OVERLOAD RATING

110% for 30 minutes

125% for 10 minutes

200% for 1 minutes

NOISE

Less than 65 dB at 1 mtr.

SWITCHING SPEED

Minimum 2 KHZ

INDICATION

Mains ON/OFF, Battery HIGH/LOW, Battery ON, Inverter ON/TRIP, O/P HIGH/LOW, Battery HIGH/LOW, Alarm for Battery Discharge.

PROTECTION

Input - Over/Under voltage, Over Current.

Battery - Over/Under Voltage, Over Current, Battery Low Alarm/Trip.

Output - Over/Under Voltage, Over Current.

Output - Short Circuit Over Temperature DC Over Current

CONTROL CIRCUITORY

Microprocessor based control circuitory be provided and all indications will be digitally displayed using microprocessor based software.

METERING

Digital display with multifunctional key panel indicates.

Output Voltage/Current

DC Voltage/Current

Output Frequency

COMMUNICATION PORT

RS 232
DIAGNOSIS & CONFIGURATION SOFTWARE

Compatible with Unix/Windows.

OUTLOOK

Compact size with aesthetically good look (specify the size and weight)

BATTERY

Lead Acid, S.M.F. for 20 minutes/1 Hr back-up under full load. Battery sizing calculations to be submitted. Make of batteries shall be Panasonic or Global Yuasa.

UPS FAILURE

During failure in the UPS equipment the static switch automatically transfer the A.C. load directly to the AC. line in less than 1/4 cycle so that transfer does not affect critical equipment operation.

HARMONIC DISTORTION OF WAVE FORM

Total harmonic distortion (THD) should be below 2% for linear load and below 3% for nonlinear load.

MAINTENANCE BYPASS SWITCH

The portion of UPS module used to connect the alternator supply to critical load while electrically isolating static switch and inverter for maintenance purpose.

BATTERY DISCONNECT SWITCH

The switch used to electrically isolate the storage batteries from UPS module.

STATIC TRANSFORMER SWITCH

The switch senses an inverter shutdown signal or degradation of inverter output item. It shall automatically transfer the loads from one inverter to the alternative AC power without interruption.

RETRANSFER TO INVERTER

The static transfer switch shall be capable of automatically retransferring the load back to inverter after the inverter has returned to normal voltage and stabilized for period of time.

QUALITY ASSURANCE

The manufacturer shall have quality assurance program with check on incoming parts and final products. A final test procedure for product shall include a check of all performance specifications and a minimum 24 hour running.

INSTALLATION DRAWING

After the receipt of order a minimum two sets of installation drawings showing outline dimension, weights and connections and a one line drawing of the UPS shall be sent to the purchaser to be used in planning the installation of the system.

PRODUCT DOCUMENTATION

Manufacturer shall supply a comprehensive set of product documentation for:

1. Installation
2. Operation

3. Maintenance

This should include complete outline and external connection drawings and schematic and physical wiring diagrams as well as parts list and parts layout down to the smallest components level. It should include startup and service manuals with complete privation and remedial maintenance and trouble showing instructions. This should include all ancillary equipment and accessories.

TRAINING

It is important that at least -2 personnel who are to be responsible for operation and maintenance of UPS be trained at the manufacturer site.

SPARE PARTS

The recommended spare parts for 5 years of maintenance are to be listed and should be quoted along with main modules.

MATERIAL AND WORKMANSHIP

1) Workmanship shall be first class in every respect.
2) All material shall be new and of best commercial grade.
3) Brackets and securing hardware shall be electroplated with corrosion resistance material.
4) Internal wiring conductors shall be combined into cable or bundles and shall be tied securely together and numbered or coded to correspond with documentation.

STORAGE BATTERY

The storage battery shall be furnished with racks connecting hardware and standard service resistance material accessories. The battery shall be delivered charged and filled ready for service.

SERVICE REPORT

Assigned field service report describing start-up and on site testing shall be furnished.

MAINTENANCE

If the battery is taken out of service for maintenance by manually opening battery disconnect switch the UPS shall continue to function and meet all the performance criteria specified except.

INVERTOR EFFICIENCY

96% minimum

PROTECTION CLASS

IP – 20

EPABX SYSTEM-

The bidder must be an OEM OR JV partner with the OEM with 25% equity participation OR Bidder should produce an undertaking from OEM in the name of client that the bidder is authorized to quote and will provide support & spares directly or indirectly for the offered system for the next 10 years. Further the OEM should also state that the offered system is latest system being manufactured by it.
The bidder must provide a list of customers with complete contact numbers, contact person name where they have commissioned similar type of EPABX.

The bidder should be able to demonstrate advance features/ solutions (those have been complied/ claimed) running in their system in this region on short notice. Features include (QSIG, IP telephony, remote shelf etc).

Valid TEC Approval for IP PBX under TEC specification number IR/PPX/-01/02, DEC’2004(IP PBX for Private use) for the Make & model quoted should be submitted along with offer for, TEC should be for 12000 IP users.

Offered exchange should be field proven & reputed make. Brand should be in India for at least 10 Years. Necessary documentation to this regard must be submitted.

The offered exchange of should have been interfaced to BSNL/ MTNL in atleast 3 locations & should have been working satisfactorily. Details of executing similar type of works shall be furnished as per attached schedule.

Bidders to submit latest ITCC, STCC & Annual Report duly certified.

The OEM should be a member of ECMA and IPNS. Test Certificates with other make exchanges certifying demo of QSIG should be attached.

Any Government body in India should not have blacklist the bidder or it’s subsidiary, dealing in similar products.

The firm should have adequate financial stability & status to meet the financial obligations of the scope of work & have a turnover of at least 15 crores from the same business during last 3 years. The bidder should submit their Profit & loss statements for the last three years.

TECHNICAL SPECIFICATIONS FOR EPABX SYSTEM

GENERAL

The specifications mentioned in the tender document are intended for the EPABX system.

EXCHANGE SPECIFICATIONS

The proposed IP EPABX system should be 100% Non-blocking switching system with ISDN/ATM compatibility. (Integrated Services Digital Network/Asynchronous Transfer Mode), configured for - Analog Extensions with CLIP, - Digital Extensions, - P&T Lines, expandable up to 10,000 Extensions.

The system should support A as well as mu law and support following compression standards on audio


Valid TEC Approval for the Make & model quoted in the name of the bidder should be submitted along with offer for; TEC should be for 12000 IP users.

The proposed IP EPABX switching technique should be confirming to latest ITU-T and CCITT standards. The EPABX should function in hot-standby duplicated configuration for all control cards and ringer section.

The system should provide complete Non-blocking digital path for Voice and Data Communication (IP Protocol). The system should also offer an in built Ethernet port management.

SYSTEM ARCHITECTURE

The offered system should be modular in design. The architecture of the EPABX should be capable of seamless migration to its maximum capacity by simply adding peripheral cards on the same set of control cards & CPU without compromising on any function/features of this system or any degradation of service.
The proposed system should follow the principle of convergence and accordingly the control should in CPCI architecture.

The system topology should be fully duplicated in terms of time slot, tone, clock highways power supply and processor. It should be based on decentralized control.

The EPABX should support linking of Homogeneous EPABX over IP with full feature transparency (distributed architecture) & IP Remote Shelf (Access points). IP Access points should be centrally administrable from the host system. Adequate details shall be furnished.

Distributed switching should be possible on IP Access points (IP Remote Shelf) also.

The system should have Universal ports for line/trunk cards. Wherein any peripheral card can be inserted in any slot of the peripheral shelf, thereby enhancing the flexibility of the configuration.

CENTRAL PROCESSING UNIT

The Central Processing Unit of the EPABX should be a 32 Bit Hierarchical Pentium based microprocessor with fully distributed controls, offering hot standby configuration with transparent switchover without disconnection of calls on occurrence of fault, covering all control cards etc.

The processed system should have the ability of Busy Hour Call Attempt (BHCA) of above 200000.

STORAGE MEDIA

The system should provide world’s latest technique of storage media (Flash EPROM or Magnetic Optical disk for higher reliability and fast booting). Please mention the storage media used for Main Memory & standby memory.

TRUNKS

ISDN (INTEGRATED SERVICES DIGITAL NETWORK): The offered exchange should be an ISDN ready switch. The system platform should be ready for ISDN and only the necessary ISDN BRI & PRI cards (Basic Rate Interface & Primary Rate Interface) need to be added for functionality (Please refer to Bill of Quantity if the requisite cards are required at present).

The system should be capable of accepting different types of signals for E1, ISDN (BRI & PRI), Ring down, 2W/4W E&M signaling etc.

The system should support E1 (30 channel PCM) level DID.

The system should have IP trunks on H.323 standards as well as SIP trunks. SIP should be supported on standard RFC3261. The system should provide SIP subscribers and SIP trunks on the same interface.

The system should support E1 & PRI on the same card. These cards should have dual (2x30 channel) modularity.

The digital card should directly take on monomode/multimode fiber on the E1 interface without use of any external device such as Optimux. External fiber interface to system shall not be acceptable.

DUPICATION

System Redundancy: The system should be provided with 100% Duplicated Control Unit in Hot standby mode. The following Duplication should be provided with the system for:

Common Control
Switching Network
Tones
Main and standby memory
Redundancy: The system should provide complete set of control cards duplication. In case of failure of one processor card the duplicated card should take over immediately with the current database, on which the system is working, without the disconnection of established calls.

The offered system should be capable of Hot Swapping of all cards without switching off the system where the necessary cards can be interchanged or replaced even in online conditions.

It should be possible to reach the ultimate capacity (10000 ports) of the switch without any upgradation of the CPU & need of additional CPU’s.

OPERATING SYSTEM

The operating system of the EPABX should be UNIX based and protected against loss/alteration of memory due to power failure/unauthorized command or due to any other faulty condition.

REMOTE SHELF

Remote shelf should be supported on Optical Fiber
A single remote shelf should support 256 channels between the main system & single remote shelf, on Optical Fiber cable.
Remote Shelf’s should also be supported on IP.
IP remote shelf’s should be available in 19” rack mountable shelf.
High voice quality for IP-based access points based on mechanism such as Echo cancellation, Voice Compression G.729A with 8 kbps, and Silence Suppression, Quality of Service Support via IP Network by traffic prioritization: IEEE 802.1 d/q and IETF DiffServ.
Remote shelf’s should be centrally administrable from the host system.

HIGH QUALITY SIGNALING

The system should provide high quality signaling earth (less than 2 ohms).

CTI APPLICATIONS

The offered system should support Computer Supported Telephone Applications (CSTA) in order to facilitate integration of LAN and IVRS.
The offered system should support CTI applications (Computer Telephony Integration) for features like Screen Popup through CLI or DNIS (Dialed Number Identification Service).
CTI should support for all 3rd party CTI solutions Call Path SeRver/2 CallPath Server 6000, CallPath SeRver/2 CallPath Server 6000, Microsoft client/server TAPI, Novell TSAPI.

VOICE MAIL

The PC based voice mail should be the same make as that of the PBX system. No external third party voice mail will be accepted. The offered voice mail system should be capable of integrating with the existing LAN/WAN and upgradable to unified communication solution (Integration of Voice mail / Fax mail / video conferencing / web conferencing etc to name a few). Users should be able to access the system internally or remotely from any phone & should be able to record standard/ personal greetings within the mailbox. The system should be able to inform the outside caller about the exact status of the desired extension (no answer/ busy). The System should also support recording of name and personalized greeting within each mailbox. System administration should be user friendly and the system should be windows based. The application development tool, which allows call flow transaction to be written & modified at site using simple menu driven command. The on line updating, changes / modification in application should be dynamically loaded/ assigned without switching off or disturbing the services.

CONFERENCE

It should be possible for extensions users up to maximum of 8 users with any combination of internal stations and also Tie Lines to talk to each other at the same time on the conference circuit. The conference call may be facility-
actuated by one of the extension users or by any attendant. Multiple 8 party conferences should be supported. Minimum 100 conferencing circuits should be available in the quoted price.

10/100 MBPS LAN Connectivity: The system should support a 10 Mbps LAN connectivity, which is to be used for maintenance configuration of the exchange.

ATM: The system should support Asynchronous Transfer Mode (ATM) by the addition of a card which resides into the system. It should be possible to use for ATM networking i.e. the implementation of PBX networks via ATM Permanent Virtual Connections (PVC) and/or ATM Switched Virtual Connections (SVC). Details of ATM card available should be furnished. The system should support UNI 4.0

Voice Over IP: The system should support voice over IP (VOIP) applications with additional hardware. The system should support integrated in built IP Gateway. Is it possible to connect IP Phones/ soft phones to the offered EPABX on H.323 standard as well as SIP

Loop Resistance: The offered system should support loop resistance for subscriber’s 1700 ohms excluding telephone sets.

Music On Hold: The system should support inbuilt music on Hold. It should also be able to Interface with an external Music system i.e. CD Player etc.

The system should have Emergency transfer to predefined CO lines in case of power failure.

PAGING & CELLULAR SYSTEM

The offered system should support integrated DECT solution. Further the system should be capable of integrating with captive and public paging systems.

NETWORKING

The offered system should work under the internationally recognized Networking protocol, QSIG. The OEM should be the member of ITSI and ECMA and IPNS forum. This is must. Bidder should also submit the required documents in support of the above qualifying criteria. Bidder should also submit documents pertaining to interworking with other exchanges.

The offered system will be equipped with a external call metering facility, fully integrated with the system.

The system should be capable of integrating with DOT approved CEPT (2MBPS) cards of Direct Inward Dialing and also for connectivity with other exchanges.

Vender should include the cost of QSIG software in the system price.

The system should support the following minimum signaling & interfaces like E&M, 2 MB CEPT, R2MFC (Digital, Analog), ISDN BRI/PRI, TSAPI, TAPI, IP Trunking, IP Gateway, ATM, LD & QSIG etc.

DECT: The IP PBX system should support DECT (Digital Enhanced Cordless Telephony).

OPERATOR CONSOLE: IP PC based operator console maximum no of IP PC Based operator Consoles should be 16.

IP PBX should have BLF (Busy Lamp Field) for ease of operation which will increase the efficiency of the operators.

IP PBX should have directory for user data base.

MAINTENANCE CONSOLE

The offered system should be provided with a PC based and software up-gradable maintenance console.
The system should be provided with a maintenance panel for command input and status display.

The system should have the compatibility to connect an external PC for maintenance programming.

The visual indications of the faults should be available at the Maintenance Console in terms of messages.

The system should support remote fault diagnosis up to card level.

Call statistic reports as required by the user should be available on the monitor as well as printouts. The formats of printouts should be programmable.

**DIAGNOSTIC AND MAINTENANCE FACILITY**

The system should have in built diagnostic features such as Isolation/detection of Faulty line/junction and restoration of faulty lines/junctions after rectification.

The offered system should have remote maintenance facility using dial up connection for remote maintenance with proper password protections.

It should be possible to maintain the system over LAN.

The EPABX should have auto restart capability to automatically reload the system software after system power is restored to it.

The system should have on line tracing facility on ISDN interface.

**PC for Voice Mail, Maintenance Console & Call Billing and Operator Console.** (With Original Windows):

Intel Core Duo,
HDD – 80 Gb
RAM- 1 GB
52 X CD ROM with Multimedia
Keyboard
Mouse
17” TFT Colour Monitor
Speakers
4 no’s of PC required

**SUBSCRIBERS FACILITIES**

The system should have the capability for tracing malicious calls.

The system should offer two way splitting of calls.

The system should provide the facility of 3 party conferences. In addition, the system should have the provision of multiple 8 party simultaneous conferences involving any kind of trunk or extension.

The offered system should have the capability of assigning to each extension a variety of specified services. Further Class of service restriction should be available to the subscribers.

Call forwarding should be available in the offered system.

The offered system should provide one no service so that the calls are always attended.

The system should support abbreviated dialing system for at least 100 numbers.

The offered system should also support multiple individual dialing groups as abbreviated dialing system.

The system should be capable of allowing the users to access all the facilities from any extension of the EPABX.
The system should allow user to assign passwords to their phones to prevent misuse of subscribers facilities provided.

Discriminative Ringing for extension calls, trunk calls, Special feature calls etc should be available

Least Call Routing through alternate public networks on different time of day basis.

Night Service: When Night service is activated the operator calls should be routed to predefined answering positions.

The offered system should have the following other features for the subscribers as below:

- Line lockout
- Hot line
- Attendant recall
- Call forwarding preset/busy/no answer
- Call hunting
- Howler tone
- Automatic call back
- Call waiting
- Station camp on ringing
- Hunting method change for each type of calls
- Recorder tone
- DND (Do Not Disturb)
- DNDO (Do Not Disturb Override)
- Variable presentable time out for Co line, Trunk lines
- Tie lines
- Consultation hold
- Call pick up
- Call parking and retrieve
- Extension grouping/intercom barring
- Fixed and delayed call forwarding
- Storage of last number dialed
- Discriminative Ringing
- Moving class of Service
- Group to Group restriction

**POWER SUPPLY**

Power Consumption of the exchange at full traffic conditions should be as low as possible. Bidders shall specify the power consumption in their offer.

A SMPS based Float cum Boost charger (FCBC) of suitable rating should be supplied, to provide the required voltage from the AC supply to the EPABX.

The offered system should be provided with maintenance free sealed batteries which can give a backup for a minimum of 04 hours.

The system should be provided with supervisory alarms for the mains failure.

Adequate protection should be provided for the system against fire & electric shocks.

The system should have an operating voltage 48 volts DC.

**HIGH QUALITY EARTH**

The resistance for the system should be limited to under 2 ohms.

The system should be provided with the necessary lightning protection as per ITU recommendations.
LIFE CYCLE

The offered exchange should have a life cycle of 10 years at least. Letter from OEM should be enclosed.

OPERATING AMBIENT CONDITIONS:
The offered system will be able to operate in ambient temperature range +5 to +45 degrees Celsius.

The system should be able to operate in relative humidity of about 30-80%.

**Push Button Telephones with CLI facility**
- 10 repertory Keys
- Last Number Redial
- Hands free duplex
- Ringer, volume adjustable (high, low), Mute
- Without external power or batteries
- Pulse or tone dialing, temporary switch over possible
- Recall key (2 flash times switchable)
- Hearing aid compatibility conforming to CCITT P

**Digital Phones:** The digital Phones should have the following features
- 06 Line display
- USB port for CTI interface
- Fully duplex
- Menu Navigating Keys
- Min 06 Programmable
- Adapter position for ISDN/ Analog Phone/ digital phone Interface
- Support for Master slave configuration
- Caller name display
- Time display
- Automatic Call back
- Adapters that should be supported: ISDN/ Analog/ digital

**Call Billing Software:** The system should come along with a windows based call billing software which supports detailed call information on all outgoing & incoming calls on trunks/ trunk groups, extensions. The records should be flexible to allow customization.

**IP Phone**
- 2 x 24 Character Tiltable Display for TYPE -1 & 06 line display for TYPE -2
- Control keys
- Navigator for Interactive user prompts
- Handsfree Operation with at least 07 fixed function keys
- Support for H.323standards and SIP
- Support for Audio Codecs G.711 & G.723.1
- Support for Quality of Service
- Support Security H.235 protocol at the work point level
- Support Power over LAN + 2 port-Mini Switch -> „One wire to the desk“
LIFT
SHOP DRAWING:

On the award of the work, the Contractor shall immediately proceed with the preparation of detailed working drawings showing the detail of each equipment that are to be installed and the associated works that are to be carried out. All the works are deemed to be included in various items of bill of quantities as applicable.

Three sets of all such working drawings duly signed by the head of the planning & design department of the tenderer shall be submitted to the consultants / Engineer-in-charge for approval to ensure that the works will be carried out in accordance with the specifications and drawings, including such changes as may have been mutually agreed upon. All the drawings shall be received by the Consultants/ Engineer-in-charge for approval within 04 (Four) weeks from the date of award of work. The approval of the drawings by the Consultants / Engineer-in-charge shall in no way relieve the Contractor from his obligations to provide a complete and satisfactory plant installation, testing and commissioning as per intent and purpose as laid down in the specifications.

Any omissions and / or errors shall be made good or rectified whether or not the drawings are approved. Contractor shall obtain written approval for samples as cable tray, cable tag, and other materials before placing the order.

The Contractor shall also fix operation schedule chart, in the Operating / Maintenance Room, neatly typed and framed, instructions in details, for the starting and running of the electrical equipment.

AS BUILT DRAWING:

At the completion of work and before issuance of certificate of virtual completion the contractor shall submit three (04) sets to the Engineer-in-charge, layout drawing drawn at appropriate scale indicating the complete Electrical System “as installed”.

INSTRUCTION/MAINTENANCE MANUAL:

The Contractor shall prepare and produce instruction, operation and maintenance manuals in English for use, operation and the maintenance of the supplied equipment and installations, and submit to the Engineer-in-charge in three copies at the time of handing over. The manual shall generally consist of the following:

a) Description of the Project.
b) Operating instructions.
c) Maintenance instructions including procedures for preventive maintenance.
d) Manufacturers catalog.
e) Spare parts list.
f) Trouble shooting charts.
g) Drawings.
i) Type and routine test certificates of major items.
j) One (1) set of reproducible ‘as built’ drawings.

LIFT:

General:

The lifts shall be A.C. variable voltage variable frequency micro processor controlled machine room.

Size & Speed:

- Passenger Lifts: 13 Pax – Speed 1.5 MPS
- Bed Lifts: 20 Pax – Speed 0.75 MPS
**Stops & Openings:**

Lifts shall be required to serve the floors as shown in attached drawing of Lift plan and sections.

**Travel:**

The travel of lifts shall be as specified.

Tenderer shall note that all dimensions are as indicated in the enclosed drawings and his design shall be based on the same. These specifications have been based on Indian standard and equipments available locally as per Indian codes and rules. Equipment from other countries will be acceptable if it is of better quality and competitive in price and conforms to International Standards. The size of hoist way and car enclosure will, however, be the same as specified namely.

**Configuration of Lifts shall be as following**

**Controls:**

Operation of Lifts shall be full collective as Triplex as specified in BOQ

**Shafts Sizes:**

The Shafts sizes shall be as follows:

- **Passenger Lifts**
  - 13 Pax 
  - 2500 mm x 1900 mm

- **Bed Lifts**
  - 20 Pax 
  - 3270 mm X 2350 mm

**Driving Mechanism:**

The lift shall be provided with A.C, variable voltage, variable frequency, microprocessor controlled motion and drive control system. The tenderer shall indicate the model No. name of manufacturer and country of origin being provided, and the cable size required.

**Operation:**

Each car shall be arranged so that momentary pressure of one or more of its buttons shall cause that car to start.

A car cannot be started unless the car door is in the closed position and all hoist way doors for that car are locked in the closed position.

All the lifts shall be provided with fireman switch.

**Operation with Attendant:**

When the key switch is in position of "without Attendant" the elevator shall operate as described above.

With the key switch in the position of "with Attendant" the direction lights and buzzer shall be operative and "up" direction and the "down" direction buttons in the regular car operating panel shall be effective for the attendant operation.
When on attendant operation, the car and hoist way doors shall open automatically at each stop but the closing of the above shall be subject to the "up" or "down" direction buttons.

As a visual signal to the attendant, the "up" or "down" direction-jewel shall illuminate upon registration either car or landing calls to indicate the travel direction of the car. The attendant shall operate the lift normally in the direction indicated by the direction-jewel. Travel may be realised by the pressure of a car button for a landing in that direction from the car and the direction button in the car operating panel for that direction.

When the key-operated independent service switch is "on" the corresponding car shall operate only from its car button and shall be entirely independent of the other car. The other car shall then operate as a Simplex Collective Elevator responding to its own car calls and all landing calls.

The pressure of direction button shall cause the doors to close and start the car in the direction desired, provided a car on landing call is registered for the direction. If pressure of the direction button is released before the car starts, the doors shall reopen. After the car has started, the direction button can be released and the car shall answer car and landing button calls.

Continuous pressure of the non-stop button shall cause the car to by-pass all landing calls and respond only to registered car calls.

In order to have a car available at the main floor while both lifts are in operation "with Attendant" a "down" light signal shall be registered. Automatically in the first car which clears all its calls. This signal shall indicate to the attendant that this car should be started "down" and pressure of the "down" direction button shall move the car automatically to the main floor.

The car shall also have emergency stop and alarm push buttons. In the machine room manual Cranking device shall be provided.

MACHINE:-

The lift machine shall be placed directly above the hoist way upon machine room slab and steel beam and directly above the Car Lift Suitable material like rubber pads of required thickness shall be used below the lift machine to reduce noise and vibrations. The machine shall be of gear type. It shall include a motor, electro mechanical brake, sheave shaft and sheave all completely mounted on a common bed plate. The hard alloy cast iron or steel sheave shall have rope grooves to ensure proper traction and minimize rope wear. Suitable means of lubrication shall be provided for all the bearing. Means for manual operation of the lift car shall be made by providing wiring wheel suitably marked to indicate the direction of the movement of car to enable the lift 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 off the electrical supply before operating manually.

MOTOR:-

The motor shall be particularly designed for elevator service with high starting torque at low speed and low running current.

BRAKE:-

The drive machinery shall be provided with an electromagnetic brake. It shall be spring applied and electrically released type.

The brake shall be capable of operating automatically by the various safety devices, current failure, the failure of any of the several units of the equipment to function in a proper manner and by normal stopping of
the car. It shall be so designed that it is capable of stopping and holding the car with load. The operation of brake shall be smooth, gradual and noiseless.

Details of brake installation should be given alongwith bid.

**CONTROL:-**

The control shall be variable voltage variable frequency.

**CONTROLLER:-**

Electro magnetic controller shall be provided with microprocessor with fully computerised control system in machine room to control starting, stopping and to automatically apply the brake in the event of power failure or on operation of safety device. The electrical contacts shall be suitable materials for long life and reliable operation without excessive wear.

**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 underneath the 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 centrifugal speed governor located at the top of the hoistway and connected to the governor through a continuous steel rope. Suitable means shall be provided to cut off power from the motor and apply the brake on application of safety. Indicate when the safety gear to stop the car shall become instantaneously operative.

**RELAYS:-**

Overload relays to protect the driving motor against overloads shall be provided.

**TERMINAL AND FINAL LIMITS:-**

Terminal switches shall be provided to stop the car at the terminal landings. These terminals switches shall act independently of the operating device or final limit 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.

**TERMINAL BUFFER:-**

Suitable spring buffers shall be installed to stop the car and counter weight at the extreme limits of travel. Buffer must be suitable for installation in the space available.

**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 the elevator. The suspension ropes shall correspond to relevant Indian Standard. Governor ropes shall also be of steel.

**CAR PLATFORM:-**

The car platform shall be framed construction and designed on the basis of rated load evenly distributed. Car platform shall be suitably designed to cater for specific designed stone floors.
CAR AND LANDING DOOR OPERATOR:–

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, operating the door when the 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 levelling.

c) The electrical and mechanical parts of all locking devices shall be substantial design and construction.

d) An electric contact for the 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 set in motion. A device shall be provided to stop and reverse the doors during their closing motion.

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 cellar and shall include shielded ball bearing. Tracks shall be suitable steel section with smooth surface. The landing doors shall also consist of heaters, sills, frames, etc. as required.

CAR DOOR SAFETY:–

Infra Red Electronic Door Detectors shall be provided for all the elevators.

CAR OPERATING PANEL IN THE CAR:–

The car operating panel in each car shall be stainless steel sheet of suitable thickness flush mounted. The panel shall contain the following:-

a) A series of push buttons numbered to correspond to the landings served.

b) An emergency stop button.

c) An emergency call button connected to a bell to serve as an emergency signal.

d) A two position key operated switch marked to indicate with attendant and without attendance.

e) A buzzer.

f) Up and down (visual) direction light jewels.

g) A nonstop button.
h) A door open button.

i) A fan switch.

j) All fixtures to be in stainless steel.

**CAR DIRECTION INDICATOR:**

Signal indication in the car shall be provided by the appropriate arrow being illuminated to indicate the direction in which the car shall next travel.

**CAR POSITION INDICATOR:**

Suitable signal indication in the car shall be provided by the appropriate numeral being illuminated when the car is passing the corresponding door. This indicator shall remain illuminated when the car is stopped at a floor. The cover of the indicator unit will be stainless steel sheet of suitable thickness:

**EMERGENCY LIGHT IN CAR:**

A battery operated emergency light point with incandescent lamp shall be provided in the car which shall operate automatically in case of power failure.

**ALARM BELL:**

An emergency alarm bell should be provided. The alarm bell shall be located in the ground floor landing and push 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.

**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 travelling 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. The button shall remain illuminated until the call is answered. The top covers of landing push button boards shall be of stainless steel sheet of suitable thickness.

**FLOOR POSITION INDICATOR:**

Suitable signal indication at all landing shall be provided by the appropriate numeral being illuminated when the car is pressing the corresponding floor. The indicator shall remain illuminated when the car is stopped at a floor. The top cover of the floor position indicator units shall be stainless steel sheet of suitable thickness.

**DETAILED INSTRUCTIONS:**

Inside the lift car suitable instructions for passenger on metallic plate shall be displayed. Such plates 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.

**FIREMAN SWITCH:**

Each lift will have fireman switch with glass front break 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 travelling upward. The doors will not open at this landing and the lift will start travelling to ground floor. In case of its travel in the downward direction when the fireman’s switch is operated, it will go straight to ground floor direct without
stopping enroute. The emergency stop button inside the car will become in-operative during the journey. Once the car has reached the ground floor, it shall be solely under the command of fireman by car buttons, landing calls being isolated. The lift can be put to normal use by putting the fireman switch in its original position.

**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.

**MICRO SELF-LEVELING:**

The lifts shall be provided with a Micro Self-Levelling feature that shall automatically bring the car to the floor landings. This Micro Levelling shall within its zone, be entirely automatic and independent of the operating device and shall correct for over-travel or under-travel and rope stretch.

**PAINTING:**

All lift metal work shall be given one shop coat of rust inhibiting paint in the factory and painted with finishing coats on site. Factory finished powder coated paint to desired shade is acceptable. Any damage caused during erection of the equipment shall be repaired to restore it to required finish.

**AUTOMATIC RESCUE DEVICE (ARD):**

All the lifts shall be programmed for ARD (Automatic Rescue Device) which shall enable the lifts to stop at the nearest floor in the event of power failure/shutdown/breakdown and the doors to be opened, so that any passengers in the lift would not be trapped inside the lift cars in such eventuality.

**WEIGHT FOR CAR INTERIOR:**

Car interior work weight should not exceed 300 kg.

**ELECTRICAL EQUIPMENT AND WIRING**

**SCOPE:**

The scope of this section comprises supply, installation and wiring of all electrical equipment including control wiring. Power supply at 415 V, 3 phase, 50 Hz, 4 wire with double earthing will be supplied by the Owner in the machine room with a MCCB in sheet steel enclosure for each lift. All further wiring to motors and controllers, hall buttons, alarm bell, car position indicators etc. shall be provided by the lift Contractor. A separate DB shall also be provided in the lift machine room for lighting, socket outlets, drilling machine, etc. by the Electrical Contractor.

**WIRING:**

All wires and cables shall be insulated with polyvinyl chloride base insulation rendered flame retardant armoured and rated for 1100 volt service and suitable for use in dry and wet locations. Makes of wires and cables shall be subject to the approval of the Consultant before delivery.

All control wiring shall be of copper.

Wires and cables subject to movement and abrasion shall be protected by flexible galvanized steel conduit.
Traveling cables shall be of best grade for the service and shall originate at steel junction boxes in hoist way and at steel junction boxes on the car, hung so that the proper size loop may be obtained. They shall have a fire and moisture resistant outer covering and contain a steel supporting strand. Traveling cables shall be suitably suspended to relieve strains in individual conductors. Traveling cables shall be provided for telephone, signals, controls, lights, fans, alarm bell, emergency circuit, music and communication with control room etc.

Earthing of all equipment is in the scope of the lift contractor.

**ELECTRIC POWER SUPPLY**

All the equipments shall be suitable for operating within a range of ± 10%. Any equipment which cannot be operated with the above mentioned power supply shall be provided with necessary Transformer / Rectifier / Stabilizer at bidder’s own cost. The power shall be provided at one point in each machine room at the location indicated by the contractor. Further power distribution shall be in the scope of the contractor.

**RULES FOR SAFETY & LABOUR WELFARE**

The CONTRACTOR shall comply with the safety and Labour Welfare Rules, as given hereunder & as per the Rules and Regulations framed by Local Authorities / Statutory Bodies / State / Central Govt. from time to time:

**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 Factory 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 (One Omni / Van with driver shall be provided at site and maintained by the CONTRACTOR at his own cost for 24 Hrs. & shall work as ambulance in case of emergency).

**SAFETY EQUIPMENT:** All necessary personal safety equipment such as Helmets (with approved colour scheme), Protective footwear, protective goggles / eye shields, Life Jacket, Gas masks etc. as considered adequate by the ENGINEER-IN-CHARGE shall be available for use of persons employed on the Site and maintained in a condition suitable for immediate use; and the CONTRACTOR shall take adequate steps to ensure proper use of equipment by those concerned.

1. Workers employed on mixing asphaltic materials, cement and lime mortars / concrete shall be provided with protective footwear and protective goggles.
2. Those engaged in handling any material which is injurious to eyes shall be provided with protective goggles.
3. Those engaged in welding works shall be provided with welder’s protective eye-shields.
4. Stone-breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
5. When workers are employed in sewers and manholes, which are in use, the CONTRACTOR shall ensure that manhole 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.
6. 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:-
No paint containing lead or lead products shall be used except in the form of paste or ready made paint.

i) 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.

ii) Overalls shall be supplied by the CONTRACTOR to workmen and adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

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 of the public. The CONTRACTOR shall provide all necessary fencing and lights to protect public from accidents and shall be bound to bear expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damage 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.

SCAFFOLDINGS:- Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely form 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, suitably footholds and hand-holes shall be provided on the ladder and the ladders shall be given an inclination not steeper than ¼ to 1 (1/4 horizontal and 1 vertical).

GUARD RAILS:- Scaffolding or staging more than 3.25 metres 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 metre 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.

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 stairways is more than 3.25 metres above ground level or floor level, it shall be closely boarded, have adequate width and be suitably forced, as described in sub-Para 4.05 above.

OPENINGS GUARDED:- Every openings 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.

EXCAVATIONS SAFETY:- All excavations, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 30 metres in length or fraction thereof, Ladder shall be extended from bottom of trench to atleast 1 metre above surface of the ground. Sides of a trench which is 1.5 metres or more in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides collapsing. Excavated materials shall not be placed within 1.5 metres of edge of excavations or half of depth of excavations whichever is more. Cutting shall be done from top to bottom. Under no circumstances shall undermining or undercutting be done.

DEMOLITION:- Before any demolition work is commenced and also during the process 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 a source of danger over a cable or apparatus used by operator shall remain electrically charged.

c) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion, or flooding. No floor, roof or other part of a building shall be so overloaded with debris or materials as to render it unsafe.

SAFETY AGAINST DROWNING:- When work is done near any place where there is risk of drowning, all necessary safety equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

HOISTING MACHINES:- Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following :-

a) i) These shall be of good mechanical construction, sound material and adequate, strength and free from patent defects and shall be kept in good repair and in good working order.

ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

b) Every crane driver of hoisting appliance / operator shall be properly qualified and no person under the age of 21 years shall be in-charge of any hoisting machine including any scaffold winch or to give signals to the operator.

c) In case of every hoisting and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every Hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.

d) In case of usage of an OWNER supplied machine, safe working load shall be notified by the Engineer-In-Charge. As regards CONTRACTOR’S machines the CONTRACTOR shall notify safe working load of each machine to the ENGINEER-IN-CHARGE whenever he brings it to site of work and get it verified by the ENGINEER-IN-CHARGE.

SAFE-GUARDS FOR MOVING & 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 a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, working apparel such as gloves, sleeves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

Necessary warning sign boards in Red / White paint, with proper lighting arrangements for nights are to be provided by CONTRACTOR at his costs, as approved by ENGINEER-IN-CHARGE at prominent locations. The arrangements for providing and maintaining all such safety and labour welfare measures etc., shall be done at CONTRACTOR’S own cost and expenses.
GREEN BUILDING SPECIFICATION
The project is being designed to attain **GRIHA 3 star and LEED Platinum rating**. The contractor has to maintain all the clauses mentioned below and also maintain the necessary documentation of the various works. Nothing extra shall be paid on account of these requirements.

Following are the contractor’s responsibilities but not limited to:

The contractor to submit the Project Management Plan showing the material storing yard, Batching Plant , facilities for labour (Accommodation, toilets etc),approach roads, site office of owner, PMC and Contractor, location for preservation of top soil, staging and spill prevention measures, erosion and sedimentation control measures etc. The plan should be such that area of disturbance should be minimum and get the same approved by Engineer-In-charge prior to start of work at site.

1. **PRESERVE AND PROTECT LANDSCAPE DURING CONSTRUCTION**

1.1 *Collection, storage and reapplication of topsoil*

1.1.1 Soil Test has to be carried out and also soil baring test needs to be carried out.

1.1.2 Contractor to ensure that the soil on-site is protected from erosion in accordance with NBC 2005 – Part 10 – Landscaping, Signs and Outdoor Display Structures, Section 1 – Landscape planning and design, Subsection 4 – Protection of landscape during construction)

1.1.3 This should be done from areas likely to be disturbed by construction activities (especially in cases where the site area is larger than 10 000 m2), topsoil should be stripped to a depth of 20 cm from the areas proposed for buildings, roads, paved areas, and external services.

1.1.4 It should be stockpiled to a height of 40 cm in designated areas and reapplied during plantation of the proposed vegetation. The topsoil should be separated from the subsoil debris and stones larger than 50 mm in diameter.

1.1.5 The adjoining areas shall be barricaded to prevent construction activities damaging the surrounding areas.

1.2 *Sedimentation basin*

1.2.1 Sedimentation basin, a temporary dam or basin at the lowest convenient point of the site should be constructed for collecting, trapping, and storing sediment produced by the construction activities.

1.2.2 A flow-detention facility must also be constructed for reducing peak run-off rates. This would allow most of the sediments to settle before the run-off is directed towards the outfall.

1.3 *Contour trenching*

1.3.1 Contour trenching is an earth embankment or ridge-and-channel arrangement constructed parallel to the contours, along the face of the slope, at regular intervals on the lengths and slopes greater than 10% (1:10),

1.3.2 They are used for reducing run-off velocity, increasing the distance of overland run-off flow. They are also used to hold moisture and minimize sediment loading of surface run-off.

1.4 *Mulching*

1.4.1 Mulch is a protective layer of material that is spread on the top of the soil, which can either be organic (such as grass clippings, straw, bark chips, and similar materials) or inorganic, (such as stones and brick chips).

1.4.2 Mulching should be used with seedings and plantings on steep slopes (slopes>33%). Steep slopes are prone to heavy erosion and, therefore, netting or anchoring should be used to hold it in place.

1.5 *Topsoil improvement*

1.5.1 Topsoil needs to be tested before preservation to ensure that it is worth preserving, and will help conserve resources and money in the long run.

1.5.2 The soil should be tested at a laboratory accredited by the Indian Council of Agricultural Research (ICAR) for primary plant nutrient and pH. In case the soil test conducted yields a result that is not up to the requisite standard, then adequate measures need to be adopted to ensure that the fertility of the soil is restored to a usable level as per the direction of Engineer-In-Charge.
1.6 Preservation of existing Trees and preventing damage to the same During Construction

During construction, protection of existing vegetation (including trees, shrubs, grasses and other plants) where possible, by preventing disturbance or damage to specified areas is recommended. This practice minimizes the amount of bare soil exposed to erosive forces.

Trees retained on the project site shall be protected during the construction period as per National Building Code – Part 10: Landscaping, signs, and outdoor display structures.

**Copy of permission letter to be provided for cutting of trees.**

1.7 Documentation

1.7.1 Site plan showing staging and spill prevention measures, erosion and sedimentation control measures.

1.7.2 Document to be submitted after completion of the project, a brief description along with photographic records to show that other areas have not been disrupted during construction. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted. (Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top soil preservation during construction).

1.7.3 Site plan (one CAD drawing) along with a narrative to demarcate areas on site from which topsoil has to be gathered, designate area where it will be stored, measures adopted for topsoil preservation.

1.7.4 Obtaining Certificate from landscape architect confirming proper protection and preservation of existing trees during construction process.

1.7.5 Landscape plan, clearly highlighting the areas where trees were removed (indicating the number of trees), if applicable, with the number of replanted trees in the proportion of 1:3 in the proposed landscape design. List details about species, which existed, and the species that have been replanted on-site.

1.7.6 Narrative explanation about the methods of soil stabilization used, wherever required, accompanied by photographs with brief description.

1.7.7 Certificate by the landscape architect on topsoil laying, soil stabilization, and adequate primary soil nutrient and pH [(supported by test results performed at Indian Council of Agricultural Research (ICAR)–accredited laboratory].

2. PROVIDE MINIMUM LEVEL OF SANITATION/SAFETY FACILITIES FOR CONSTRUCTION WORKERS

2.1.1 Drinking water facility provided for workers, all such points shall be legibly marked "Drinking Water" in a language understood by a majority of the persons employed in such place and no such point shall be situated within six meters of any washing place, urinal or latrine.

2.1.2 Contractor shall provide minimum level of sanitation facilities and ensure safety of construction workers as per guidelines given in The National Building Code of India (Latest version). Toilets provided for workers, the temporary accommodation provided shall have separate cooking place, bathing, washing and lavatory facilities.

2.1.3 Provision for crèche if female workers: Such rooms shall- provide adequate accommodation; be adequately lighted and ventilated; be maintained in a clean and sanitary condition; be under the charge of women trained in the care of children and infants.

2.1.4 To provide and maintain in every place wherein not less than two hundred and fifty building workers are ordinarily employed a canteen for the use of the workers;
2.1.5 Safety helmets, vests, boots and safety harness should be provided mandatorily.

2.1.6 In case of any death or injury on the site, by reason of which the person injured is prevented from working for the period of forty-eight hours or more immediately following the accident, or which is of such a nature as may be prescribed.

2.2 **Documentation**

Contractor shall take regular photographs showing the health, safety and sanitation measure followed during construction and maintain the record of the same.

Contractor shall submit the detailed narrative on provision for safe drinking water and sanitation facility for construction workers and site personnel accompanied by the photographs taken at regular intervals during construction.

3 **REDUCE AIR POLLUTION DURING CONSTRUCTION**

Contractor shall prepare a dust and air pollution control plan and get the same approved by Engineer-In-Charge prior to start of construction.

3.1.1 **Barricading**

Temporary and permanent barricading shall be provided in height around construction area of either full brick wall or dust screens, sheeting or netting has to be provided along the sides of existing building and road.

3.1.2 **Wheel Washing Pit**

Construct and maintain the wheel washing pit to prevent erosion by construction vehicles at all entrances of the site.

3.1.3 **Water spraying**

Use water as a dust suppressant. Spray water over areas where demolition work is being carried out. Ensure that all vehicles and gensets use cleaner fossil fuels like ultra low sulphur diesel.

3.2 **Cover and enclosure**

Cover all loose stored material with geotextile or any impervious fabric or covering.

Cover all dusty loads on vehicles with impervious sheeting before they enter or exit the site.

Store loose materials in enclosed spaces. Provide wind barriers or fences or wind breakers around the area where loose soil, sand, etc., are stored.

Store materials on site in an area away from sensitive areas surrounding the site like schools, hospitals, etc.

All gensets should be maintained properly. The gensets used on site should meet the recommended pollution norms. Minimum stack height should be provided for all gensets based on height of the building and capacity of the gensets.

The contractor shall submit the narrative document with support of site photographs demonstrating implementation of actual measure and a short description of each measure.

3.3 **Documentation**

Contractor to submit the narrative (not more than 300 words) explaining the air pollution preventive measures that have been adopted on-site. Site photographs showing different stages of construction along with preventive measures to support of the same.
4  
EFFECTIVE WATER USE DURING CONSTRUCTION

4.1.1 Contractor shall use curing compound for curing the concrete as per the specifications mentioned elsewhere in the tender document.

4.1.2 Curing water should be sprayed on concrete structures; free flow of water should not be allowed for curing.

4.1.3 After liberal curing on the first day, all concrete structures should be painted with curing chemical to save water. This will stop daily water curing hence save water.

4.1.4 Concrete structures should be covered with thick cloth/gunny bags and then water should be sprayed on them. This would avoid water rebound and will ensure sustained and complete curing.

4.1.5 Ponds should be made using cement and sand mortar to avoid water flowing away from the flat surface while curing.

4.1.6 Water ponding should be done on all sunken slabs.

4.1.7 Adequate provision for recycling of waste water generated on site during construction activities.

4.1.8 Adequate storage provision for rain-water and reuse on site.

4.1.9 Recycled treated water to be used for curing

4.2 Documentation

Contractor to submit the narrative explaining the effective water use during construction accompanied by regular photographs of curing showing the use of concrete compound as per the direction of Engineer-In-Charge.

5 USE OF LOW-VOC PAINTS/ADHESIVES/SEALANTS

Contractor to ensure that all the Adhesives, Sealants, Paints and Coatings used in the project have a VOC level within the following limits. Maintain Proper documentation in the form of manufacturer cut sheets, technical data sheets, and lab test reports as conformation for compliance.

100% of all paints should be under the provided VOC limits for paints and to use water–based rather than solvent-based sealants and adhesives.

<table>
<thead>
<tr>
<th>Paint applications</th>
<th>VOC limits (g of VOC per lt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior coating</td>
<td>Flat &lt;50</td>
</tr>
<tr>
<td>Non Flat &lt; 150</td>
<td></td>
</tr>
<tr>
<td>Exterior Coating</td>
<td>Flat &lt;200</td>
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<tr>
<td></td>
<td>Non Flat &lt;100</td>
</tr>
<tr>
<td>Anti Corrosive</td>
<td>Gloss/semi gloss/flat &lt; 250</td>
</tr>
</tbody>
</table>

6 STORM WATER MANAGEMENT DURING CONSTRUCTION:

Contractor needs to take measures to ensure that the storm water runoff during construction does not exceed the runoff before construction. To this effect there is need to provide rain water recharge pits right around the periphery of the site & have rain water harvesting wells to capture rain water and then filter all suspended solids and other materials before recharge into the earth.

CONSTRUCTION WASTE MANAGEMENT

REDUCTION IN WASTE DURING CONSTRUCTION

7.1.1 Separate bins to be constructed for storage of sand and aggregate.

7.1.2 Separate bins to be constructed for storage of construction waste like scrape steel, cement debris, empty cement bags, paint buckets etc and other construction wastes.

7.1.3 Hazardous wastes like spent diesel and batteries be also sold to designated vendors 7.1.4 Spent diesel shall not be reused as shuttering oil or for any other construction purpose.

7.2 Documentation

Contractor to submit the narrative indicating the quantum of waste generated during construction and storage facility for segregated inert and hazardous waste before recycling and disposal accompanied by necessary documents and photographs.
Contractor to submit the layout (showing the location & capacity) and photo of the storage facility for segregated inert and hazardous waste

Contractor to ensure that a plan is in place to ensure that more than 75% of the waste generated by weight or volume, on-site due to construction activities is either reused, recycled or sold as scrap and is diverted from going into landfills.

Contractor to submit the proper records/documents in the form of logs, photographs, gate passes, hauler certificates, etc. for compliance of the same.

Contractor to submit the proper records/documents in the form of logs, photographs, gate passes, hauler certificates, etc. for compliance of the same.

8 Recycled Content in Materials
Contractor to submit the letters confirming the recycled content (post-consumer and pre-consumer) in the materials from the manufacturers. Recycled content in the various materials is given below:
   a. Glass - Minimum recycled content of 10-15%
   b. Steel – Minimum recycled content of 25%
   c. Gypsum Board- Minimum recycled content of 20-25%
   d. Aluminum - Minimum recycled content of 25%
   e. Fly sash in AAC Blocks, Cement Plaster, RMC- Minimum recycled content of 25-50%

Contractor to maintain documentation records in the form of Manufacturer cut-sheets, Technical data sheets and/or test reports to confirm compliance of the same. Post-consumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

9 Regional Materials
Contractor to procure materials which are extracted, harvested or recovered and manufactured/processed within a 250 mile (400km) radius of the project site as far as possible and ensure that more than 20% of the materials by cost are extracted, harvested or recovered and manufactured/processed regionally within a 250 mile (400km) radius.

Contractor to maintain and submit documentation records in the form of Manufacturer letters indicating the place of manufacture/process and place of raw material extraction/harvesting and the distance of both from the project site to ensure compliance with the above.

10 Composite Wood and Agrifiber Products
Composite wood and agrifiber products used in the interior of the building must contain no added urea-formaldehyde resins. Composite wood and agrifiber products are defined as: particleboard, medium density fibreboard (MDF), plywood, wheat board, strawboard, panel substrates and door cores. Substitute resins include Phenol Formaldehyde, Melamine Formaldehyde or Epoxy resins

Contractor to submit and maintain proper documentation in the form of manufacture cut sheets, technical data sheets, lab test reports indicating the resin used for all composite wood and agrifiber products as conformation for compliance.

**ADDITIONAL SPECIAL CONDITIONS – GRIHA**
In order to comply with the criterion laid down by GRIHA following mandatory practices shall be followed by the contractor. In addition the tender rates shall be deemed to include the following:
A. The contractor shall comply with safety procedures, norms and guidelines (as applicable) as outlined in the Doc No. CED 46(6086), July 2003: Draft National Building Code of India: Part 7 Constructional practices and safety, issued by Bureau of Indian Standards.

I. Site Boundary
Boundary shall be fenced with an opaque material which shall not allow air pollution and soil erosion due to wind. Temporary and permanent barricading shall be provided in height around construction area of either full brick wall or dust screens, sheeting or netting has to be provided along the sides of existing building and road.

II. Site preparation
- Clear vegetation only from the areas where work will start right away
- Vegetate / mulch areas where vehicles don’t ply. Mulch is a protective layer of material that is spread on the top of the soil, which can either be organic (such as grass clippings, straw, bark chips, and similar materials) or inorganic, (such as stones and brick chips). Mulching should be used with seedings and plantings on steep slopes (slopes>33%). Steep slopes are prone to heavy erosion and, therefore, netting or anchoring should be used to hold it in place.
- Apply gravel to the area where mulching/paving is impractical
- Identify roads on site that would be used for vehicular traffic. Add surface gravel to reduce source of dust emission
- Limit vehicular speed on site to 10 km/hour

III. Existing Site Features
- Conserve existing natural areas or existing natural features on site such as water bodies, trees etc to integrate in the design and to provide habitat and promote biodiversity
- Carry out a comprehensive site analysis to identify site characteristics that can be used to harness natural resources (like solar energy, wind, and water) and the potential qualities of the landforms that could contribute to making different areas of the site visually and thermally more comfortable for users. Locate various activities of the scheme after careful site analysis and assessment so as to protect ecologically sensitive areas and reduce damage to the natural ecosystem

IV. A. Preserve and protect existing vegetation on site
- Inventory of existing vegetation including the number of trees and native shrub coverage and their species types. This has to be done before any construction activity starts on site
- Preserve existing mature trees on-site during the course of construction by preserving and transplanting them. Preservation and protection of existing vegetation by non-disturbance or damage to specified site areas is recommended. Site vegetation includes trees, shrubs, grasses and other plants. Where ever possible, existing site vegetation has to be included in the landscape design of the site. This practice enables retention of fully-grown mature trees and also reduces avoidable erosion of bare soil
- The contractor shall undertake the responsibility to ensure that the site is not ‘levelled’ or ‘cleared’ before undertaking this study
- Site plan, with photographs, clearly highlighting the trees and native shrub coverage that is protected, transplanted or removed has to be recorded or maintained by the site engineer

B. Procedure to Monitor and Protect Site Vegetation
- All existing vegetation shall be marked on a site survey plan
- A vegetation survey in the prescribed format shall be carried out by an accredited landscape architect and attached to the site survey plan
The above specifications to be implemented at site as per NBC part 10 – Landscaping, Signs and outdoor display

Copy of permission letter to be provided for cutting of trees.

C. Transplanting Existing Trees on Site

- If trees have to be removed from their location or have to be felled for any of the above reasons, efforts should be made to transplant them as much as possible. For this
- Large trees identified for transplantation should be replanted at a different location immediately
- Young trees or saplings identified for transplantation can be uprooted and preserved for replanting after the completion of construction. Young trees are those that have a height less than 2 m, and a 0.1 m trunk girth at 1 m height from ground, and a 2 m crown diameter
- Non Applicability condition: Sites that are devoid of trees

D. Compensatory Plantation on Site

- Where trees cannot be transplanted due technical and economical reasons, compensatory plantation has to be undertaken on the site.
- Compensate the loss of vegetation (trees) due to the construction activity by compensatory plantation.
- Replant the same number of mature or fully grown trees as eliminated during the construction of the proposed landscape design. Replant the same, native and/or non-invasive species, which existed on the site before elimination in the proportion of 1:3.
- Plant in excess of 25% to the minimum required within the site premises
- The above specifications to be implemented at site as per NBC part 10 – Landscaping, Signs and outdoor display

V. Construction management process requirements

A. Timing of construction

- Select proper timing for the construction activity to minimize site disturbance such as soil pollution due to spilling of the construction material and its mixing with rainwater

B. Staging

- Staging is dividing a construction area into two or more areas to minimize the area of soil that will be exposed at any given time. Staging should be done to separate undisturbed land from land disturbed by construction activity and material storage
- Use staging and spill prevention and control plan to restrict the spilling of the contaminated material on site
- Specify and limit construction activity in pre-planned/designated areas

C. Soil erosion and sedimentation control measures

- Soil Test has to be carried out and also soil baring test needs to be carried out. Topsoil needs to be tested before preservation to ensure that it is worth preserving, and will help conserve resources and money in the long run.
- The soil should be tested at a laboratory accredited by the Indian Council of Agricultural Research (ICAR) for primary plant nutrient and pH. In case the soil test conducted yields a result that is not up to the requisite standard, then adequate measures need to be adopted to ensure that the fertility of the soil is restored to a usable level as per the direction of Engineer-In-Charge.
• Preserve topsoil by employing measures as following -
  • Contractor to ensure that the soil on-site is protected from erosion in accordance with NBC 2005 – Part 10 – Landscaping, Signs and Outdoor Display Structures, Section 1 – Landscape planning and design, Subsection 4 – Protection of landscape during construction)

• Protect the top soil from erosion. Use collection storage and reapplication of the top soil, sediment basin, contour trenching, mulching, soil stabilization methods to protect the top soil from erosion during construction
• Measures shall be followed for collecting drainage water runoff from construction areas and material storage sites through temporary drainage trenches, silt fences, bio-infiltration ponds or structural controls such as sedimentation tank or water collection chambers to reuse water for curing etc.
• The Contractor shall construct Sedimentation basin, a temporary dam or basin at the lowest convenient point of the site. This should be constructed for collecting, trapping, and storing sediment produced by the construction activities, together with a flow detention facility for reducing peak runoff rates. This would allow most of the sediments to settle before the runoff is directed towards the outfall

D. Soil conservation (till post-construction)
• Proper topsoil laying, stabilization of the soil, and maintenance of adequate fertility of the soil to support vegetative growth. The top soil conservation should be done from areas likely to be disturbed by construction activities (especially in cases where the site area is larger than 10 000 m²), topsoil should be stripped to a depth of 20 cm from the areas proposed for buildings, roads, paved areas, and external services.

• It should be stockpiled to a height of 40 cm in designated areas and reapplied during plantation of the proposed vegetation. The topsoil should be separated from the subsoil debris and stones larger than 50 mm in diameter.
• The adjoining areas shall be barricaded to prevent construction activities damaging the surrounding areas
• Non applicability condition proposed (for top soil preservation only): Contaminated sites/sites that do not have good quality top soil (as per soil test report) that is considered worth storing for reuse. Soil test has to be carried out as per criteria 3 and the test report has to be endorsed by the landscape architect. The landscape architect has to provide certificate that the top soil is not worth storing for landscaping purposes and cannot be restored to applicable standard

VI. Reduce air pollution during construction
• The contractor shall undertake the responsibility to prevent air pollution dust and smoke; ensure that there will be adequate water supply / storage for dust suppression; devise and arrange methods of working and carrying out the work in such a manner as to minimize the impact of dust on the surrounding environment, and provide experienced personnel with suitable training to ensure that these methods of working, plant, equipment and air pollution control system to be used on the site should be made available for the inspection and approval of the engineer-in-charge of construction to ensure that these are suitable for the project
• The contractor shall comply to CPCB standards to prevent air pollution, dust and smoke on the site. These standards shall be applicable to the use of DG sets during construction and the stack height of the DG stack to control air pollution should be as per the CPCB standards

Site maintenance policies should include -
A. Water spraying.
• This will be done by wetting the surface by spraying water on-
• Any dusty materials before transferring, loading, and unloading.
• Areas where demolition work is being carried out
• Any unpaved main haul road
• Areas where excavation or earth-moving activities are to be carried out

B. Cover and Enclosure
• Providing hoardings/ GI sheet barricading of not less than 3m high along the site boundary, next to a road or other public area. An existing brick boundary wall exists at site on some sides. The Contractor shall be required to erect a GI sheet barricading over the same
• Providing dust screens, sheeting or netting along the perimeter of a building
• Covering fully stockpile of dusty material with impervious sheeting
• Covering dusty load on vehicles by impervious sheeting before they leave the site.
• Transferring, handling/storing dry loose materials like bulk cement, dry pulverized fly ash inside a totally enclosed system
• Stack height of the DG stack to control air pollution should be as per the CPCB standards

VII. Reduce Noise Pollution during construction on site
• To use appropriate noise controls for providing acceptable levels of outdoor and indoor noise levels to enhance comfort ensure that the outdoor noise level conforms to the Central Pollution Control Board-Environmental Standards-Noise (ambient standards)
• The report on measured average ambient noise level at site- Noise measurement should be conducted by an organization recognized by a competent authority and it should follow procedures laid down by a competent authority.
• Mechanical, electrical, air conditioning, heating and mechanical ventilation and other services if are provided -noise control measures should be incorporated during the design and installation of such services to adhere to the recommended outdoor and indoor noise criteria for the kind of occupancy
• Some basic techniques to achieve the same are given in National Building Code, Part - VIII, Section 4, Annex G

VIII. Aggregate Utility corridors
• Use aggregate utility corridors
• Consolidate utility corridors along the previously disturbed areas or along new roads, in order to minimize unnecessary cutting and trenching and to ensure easy maintenance. Local codes and requirements for water, sewer, and electrical/telecommunication lines should be considered.
• Consolidate services, pedestrian, and automobile paths

IX. Efficient Water Use during Construction
• Minimize use of potable water during construction activity by-
• Controlling wastes of curing water
• To avoid wastage of curing water, follow the following guidelines
• Curing water should be sprayed on concrete structures; free flow of water shall not be allowed.
• After liberal curing on the first day, all concrete structures shall be painted with curing chemical to save water. This will stop daily water curing hence save water. (to be covered under tender items)
• Concrete structure shall be covered with thick cloth/gunny bags and then water should be sprayed on them. This would avoid water rebound and ensure sustained and complete curing.
• Ponds shall be made using cement and sand mortar to avoid water flow away from the flat surface while curing (to be covered under tender items)
• Water ponding shall be done on all sunken slabs; this would also highlight the importance of having an impervious formwork.
• Use recycled treated water
• **Storm water management during construction**
  o Contractor needs to take measures to ensure that the storm water runoff during construction does not exceed the runoff before construction. To this effect there is need to provide rain water recharge pits right around the periphery of the site & have rain water harvesting wells to capture rain water and then filter all suspended solids and other materials before recharge into the earth.

**X. Utilization of flyash in building structure**
- **Fly ash use in RC**: Minimum 15% replacement of cement with fly ash by weight of cement used in the total structural concrete. Provide supporting document from the manufacturer of the cement specifying the fly ash content in PPC used in reinforced concrete.
- **For use of fly ash in building blocks of load bearing and non-load bearing wall**: Minimum 40% replacement of cement with fly ash by weight, for 100% load bearing and non-load bearing walls. Provide supporting document from the manufacturer of the pre-cast building blocks specifying the fly ash content of the blocks used in an infill wall system.
- **For use of fly ash in plaster and masonry mortar**: Minimum 30% use of fly ash in place of cement by weight in overall plaster and mortar requirement. Provide supporting document from the manufacturer of the cement/ready mix concrete, specifying the fly ash content in PPC used in plaster and masonry mortar.

**XI. Use of low VOC paints adhesives and sealants**
Contractor to ensure that all the Adhesives, Sealants, Paints and Coatings used in the project have a VOC level within the following limits. Maintain Proper documentation in the form of manufacturer cut sheets, technical data sheets, and lab test reports as conformation for compliance. 100% of all paints should be under the provided VOC limits for paints and to use water–based rather than solvent-based sealants and adhesives.

<table>
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<tr>
<th>Paint applications</th>
<th>VOC limits (g of VOC per lt)</th>
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<tr>
<td>Interior coating</td>
<td>Flat &lt;50, Non Flat &lt; 150</td>
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<tr>
<td>Exterior Coating</td>
<td>Flat &lt;200, Non Flat &lt;100</td>
</tr>
<tr>
<td>Anti Corrosive</td>
<td>Gloss/semi gloss/flat &lt; 250</td>
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</tbody>
</table>

**XII Recycled Content in materials**
Contractor to submit the letters confirming the recycled content (post-consumer and pre-consumer) in the materials from the manufacturers. Recycled content in the various materials is given below:

- **Glass**: Minimum recycled content of 10-15%
- **Steel**: Minimum recycled content of 25%
- **Gypsum Board**: Minimum recycled content of 20-25%
- **Aluminium**: Minimum recycled content of 25%
- **Flyash in AAC Blocks, Cement Plaster, RMC**: Minimum recycled content of 25-50%

Contractor to maintain documentation records in the form of Manufacturer cut-sheets, Technical data sheets and/or test reports to confirm compliance of the same. Post-consumer material is defined as waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. Pre-consumer material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

**XIII Regional Materials**
Contractor to procure materials which are extracted, harvested or recovered and manufactured/processed within a 250mile (400km) radius of the project site as far as possible and ensure that more than 20% of the materials by cost are extracted, harvested or recovered and manufactured / processed regionally within a 250mile (400km) radius.
Contractor to maintain and submit documentation records in the form of Manufacturer letters indicating the place of manufacture/process and place of raw material extraction/harvesting and the distance of both from the project site to ensure compliance with the above.

_XIV. Reduce volume and weight and time of construction by adopting efficient technologies_

**Structural application**
- Use of low-energy technologies in structural application clearly demonstrating a minimum 5% reduction in high energy materials such as cement, concrete, steel, sand, bricks by absolute volume when compared with equivalent products for the same application, for 100% structural system used in a building, meeting the equivalent strength requirements. For e.g. Post tensioned systems, precast systems etc.

**Non-structural application**
- Use of low-energy technologies/materials (not based on the utilization of industrial waste), which are used for non-structural applications such as infill wall system and cause a minimum 5% reduction in the use of high-energy materials such as cement, concrete, steel, and so on, by absolute volume when compared with equivalent products for the same application, for 100% infill wall system used in a building, meeting the equivalent strength requirements. For e.g. light weight concrete blocks over dense concrete blocks, pre-cast brick panels, composite ferrocement walling, interlocking concrete blocks etc.

_XV. Reduction in the Waste during Construction_

- The contractor is required to develop Waste Management Programme (WMP) during the construction of the project for his works, which may include:
  - The Contractor shall ensure maximum recovery and safe disposal of wastes generated during construction and reduce the burden on landfill.
  - Employ measures to segregate the waste at site into inert, chemical, or hazardous wastes. For this the contractor shall construct separate coloured bins for collection of different categories of waste at site and maintain strict discipline among the labour in segregating the waste.
  - The Contractor shall recycle the unused chemical/ hazardous wastes such as oil, paint, batteries and asbestos. The Contractor shall dispose off the inert waste by Municipal Corporation at landfill sites.
  - Minimize factors that contribute to waste such as over-packaging, improper storage, ordering errors, poor planning, breakage, mishandling, and contamination of construction materials. For waste volumes generated, identify and institute reuse, salvage and recycle opportunities whenever economics and logistics allow.
  - Develop and institute a construction waste management plan that identifies proposed deconstruction and salvage opportunities, on-site reprocessing and reuse opportunities.

_XVI. Storage of materials and equipment at site_

- The Contractor shall, at his own cost, provide adequate storage sheds and yards at the Site, at locations pre-approved by the Engineer, for all materials and equipment that are to be incorporated in the Work. This shall be for all the materials and equipment, supplied by the Contractor or any Sub-Contractor or supplied by the Employer / Engineer.
- In addition to being watertight and weatherproof, the storage facilities shall be of such a manner that all the materials and equipments are adequately protected in every way from any deterioration or contamination or damage whatsoever, to the complete satisfaction of the Engineer. The method of storing of all the materials and equipment shall be in conformity with the Specifications and/or to the directions and instructions of the Engineer. At no time shall any material or equipment be stored in open or in
contact with the ground. Should any of the materials or equipment deteriorate or be contaminated or damaged in any way due to improper storage or for any other reason than such materials and equipment shall not be incorporated in the Work and shall be removed forthwith from the Site and the replacement of all such materials and equipment shall be entirely at the cost and expense of the Contractor

• Wherever applicable the storage of materials shall be in accordance with the relevant Indian Standard Specifications

**XvII. Provide at least the minimum level of accessibility for persons with disabilities as applicable**

• Ensure access to facilities and services by adopting appropriate site planning to eliminate barriers as per the recommended standards (NBC 2005 [BIS 2005f]), layout and designing of interior and exterior facilities as per principles of universal design such as prescribed by the National Building Code of India, building management policies and procedures, provision of auxiliary aids and appliances, and staff training in disability awareness, and

• Comply with planning and design guidelines as outlined in NBC 2005 Annex D (Clause 12.21) (BIS 2005f)

**XVII. Documentation**

• Site plan showing staging and spill prevention measures, erosion and sedimentation control measures.

• Document to be submitted after completion of the project, a brief description along with photographic records to show that other areas have not been disrupted during construction. The document should also include brief explanation and photographic records to show erosion and sedimentation control measures adopted. (Document CAD drawing showing site plan details of existing vegetation, existing buildings, existing slopes and site drainage pattern, staging and spill prevention measures, erosion and sedimentation control measures and measures adopted for top soil preservation during construction).

• Site plan (one CAD drawing) along with a narrative to demarcate areas on site from which topsoil has to be gathered, designate area where it will be stored, measures adopted for topsoil preservation.

• Obtaining Certificate from landscape architect confirming proper protection and preservation of existing trees during construction process.

• Landscape plan, clearly highlighting the areas where trees were removed (indicating the number of trees), if applicable, with the number of replanted trees in the proportion of 1:3 in the proposed landscape design. List details about species, which existed, and the species that have been replanted on-site.

• Narrative explanation about the methods of soil stabilization used, wherever required, accompanied by photographs with brief description.

• Certificate by the landscape architect on topsoil laying, soil stabilization, and adequate primary soil nutrient and pH [(supported by test results performed at Indian Council of Agricultural Research (ICAR)–accredited laboratory].

• Contractor shall take regular photographs showing the health, safety and sanitation measure followed during construction and maintain the record of the same.

• Contractor shall submit the detailed narrative on provision for safe drinking water and sanitation facility for construction workers and site personnel accompanied by the photographs taken at regular intervals during construction.

• Contractor to submit the narrative (not more than 300 words) explaining the air pollution preventive measures that have been adopted on-site. Site photographs showing different stages of construction along with preventive measures to support of the same.

• Contractor to submit the narrative indicating the quantum of waste generated during construction and storage facility for segregated inert and hazardous waste before recycling and disposal accompanied by necessary documents and photographs.

• Contractor to submit the layout (showing the location & capacity) and photo of the storage facility for segregated inert and hazardous waste
• Contractor to ensure that a plan is in place to ensure that more than 75% of the waste generated by weight or volume, on-site due to construction activities is either reused, recycled or sold as scrap and is diverted from going into landfills.

• Contractor to submit the proper records/documents in the form of logs, photographs, gate passes, hauler certificates, etc. for compliance of the same.
LIST OF APPROVED MAKES
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<th>Sl. no.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
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</thead>
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<tr>
<td>1</td>
<td>Grey Cement (OPC 43 Grade)</td>
<td>ACC, Ultratech, JP, Ambuja</td>
</tr>
<tr>
<td>2</td>
<td>Portland Slag Cement</td>
<td>ACC, Ultratech, JP, Ambuja</td>
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<tr>
<td>3</td>
<td>Portland Pozzolana Cement (Flyash)</td>
<td>ACC, Ultratech, JP, Ambuja</td>
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<td>4</td>
<td>White Cement</td>
<td>J.K. Birla or equivalent</td>
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<tr>
<td>5</td>
<td>Reinforcement Steel (TMT bars)</td>
<td>Tata, sail, Rashtriya Ispat Nigam</td>
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<td>6</td>
<td>Structural Steel sections</td>
<td>Sail, Vizag, Tata</td>
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<td>Concrete Additives</td>
<td>Fosroc, Choksey, SikKa</td>
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<td>Anti termite Chemical</td>
<td>Pest Control India Ltd., Pest Con India, or Equivalent</td>
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<td>Tile grouts, Joint Filler</td>
<td>Laticrete, Bal Endura, GE Bayer Silicon</td>
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<td>10</td>
<td>Polysulphide Sealant</td>
<td>Fosroc, Choksey, Pidilite</td>
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<td>11</td>
<td>Silicone Sealant</td>
<td>GE Bayer Silicone, Dow Corning, Wacker.</td>
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<td>Epoxy</td>
<td>Fosroc, Sika, Choksey , BASF</td>
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<td>Water Proofing Membrane – Bitumen Based</td>
<td>Sikka, Fosroc, BASF</td>
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<td>Admixture</td>
<td>Choksey , BASF, Fosroc</td>
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<td>Formwork Release Agent</td>
<td>Choksey, MBT, BASF</td>
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<td>Non Metallic Floor Hardeners</td>
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<td>Bitumen</td>
<td>Shalimar tar products, Mathura oil refinery</td>
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<td>Synthetic Enamel Paints</td>
<td>Berger , Nerolac, Asian , ICI Dulux ,</td>
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<td>Oil Bound Distemper</td>
<td>Berger , Nerolac, Asian , ICI Dulux ,</td>
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<td>Cement Paint</td>
<td>Snowcem Plus, Berger, Nerolac</td>
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<td>Plastic Emulsion Paint</td>
<td>Berger, ICI, Nerolac, Asian</td>
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<td>Other Paints &amp; Primer</td>
<td>ICI Dulux, Asian, Berger, Nerolac</td>
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<td>Textured Coating/Paint</td>
<td>Heritage, Unitle, Spectrum</td>
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<td>Melamine</td>
<td>ICI Dulux, Timberstone Melamine Coating,</td>
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<td>Silicon Water Repellent Solution</td>
<td>GE Bayer Silicone, Choksy chemicals, Bal Endura, BASF</td>
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<td>28</td>
<td>Ceramic Tiles (Glazed , Matt , Others)</td>
<td>Kajaria, RAK. NITCO, Somany</td>
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<td>29</td>
<td>Vitrified Tiles</td>
<td>Kajaria, Rak, , NITCO, Somany</td>
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<td>Laminated Wooden flooring</td>
<td>Pergo, Berry. Floor Master</td>
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<td>Polyflor , Ger Floor , Tarkett ,</td>
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<td>NITCO, Unistone, Hindustan</td>
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<td>Interlock Tiles, Grass Paver Block</td>
<td>Nimco Prefab, K K Manhole, Hindustan</td>
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<td>Cement Concrete Tiles, Designer Tiles</td>
<td>Unistone, Dazzle, Eurocorn,</td>
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<td>Laminates &amp; veneers</td>
<td>Century, Greenply ,Merino ,Archidply</td>
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<td>MDF Grade-I as per IS-12406&amp; Ecomark</td>
<td>Century, Greenply ,Merino ,Archidply</td>
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<td>Dunlop, Fevicol,</td>
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<td>Century, Greenply ,Merino ,Archidply, Modify</td>
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<td>Paving Stones</td>
<td>Unistone , Nimco Prefab, K K Manhole, Hindustan</td>
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<td>Supreme Industries or Equivalent</td>
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<td>Stainless Steel Hinges</td>
<td>Hettich, Doorset, Godrej, Dorma, Hardwyn</td>
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<td>Modi Float Glass, Asahi Glass, Saint Gobain</td>
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<td>Door Hardware</td>
<td>Godrej, Dorma, Hettich, Hardwyn</td>
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<td>D-Line, Sign Sutra, Sameer</td>
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<tr>
<td>71</td>
<td>Pre-Engineered Building</td>
<td>Kirby Building, Tiger Steel or equivalent</td>
</tr>
<tr>
<td>72</td>
<td>Flush Doors</td>
<td>Merino, Greenlam, Century, Archidply, Modiply</td>
</tr>
<tr>
<td>73</td>
<td>MS Sliding Motorized Door</td>
<td>Shivam Associates - Beninca RI524 K System or equivalent</td>
</tr>
<tr>
<td>74</td>
<td>Water proofing compound</td>
<td>Pidilite, Cico, Fosroc, Choksey, Mapei</td>
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<tr>
<td>75</td>
<td>Fasteners</td>
<td>Gun, Atul, Hilti, Canon</td>
</tr>
<tr>
<td>76</td>
<td>Aluminum fittings</td>
<td>Crown, Nulite, Mccoy</td>
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<tr>
<td>77</td>
<td>Extruded vitrified clay tile</td>
<td>Duvtex, Unistone, Pioneer</td>
</tr>
<tr>
<td>78</td>
<td>POP</td>
<td>Sriram or equivalent</td>
</tr>
<tr>
<td>79</td>
<td>outdoor furniture (sitting bench, dustbin)</td>
<td>Arihant or equivalent</td>
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<tr>
<td>80</td>
<td>Modular furniture</td>
<td>Godrej, HNI, Featherlite</td>
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<tr>
<td>81</td>
<td>Chairs and Sofas</td>
<td>Godrej, HNI, Featherlite</td>
</tr>
<tr>
<td>82</td>
<td>Acoustical paneling</td>
<td>Absound overseas, Anutone, Armstrong</td>
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<td>Modular Toilets</td>
<td>Merino, Dorma, Trespa</td>
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<td>Page 84</td>
<td>Mosaic tiles</td>
<td>Nitco, surya, Laxmi</td>
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<td>Page 85</td>
<td>Acoustical False Ceiling</td>
<td>Absound overseas, Anutone, Armstrong</td>
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<td>Page 86</td>
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<td>Duvetex, Unistone, Pioneer</td>
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<td>Page 87</td>
<td>Patch Fitting/ Spider Fitting</td>
<td>D-Line, Hettich, Dorma, Hardwyn</td>
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<td>UPVC Door &amp; Window</td>
<td>Fenesta or Equivalent</td>
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<td>Page 89</td>
<td>Acid and alkali resistant tiles</td>
<td>Kajaria, NITCO, Durato</td>
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<tr>
<td>Page 90</td>
<td>Ceramic and alkali resistant tiles</td>
<td>Terial, Soladrilho</td>
</tr>
</tbody>
</table>

### ELECTRICAL

**A. ELECTRICAL HIGH SIDE EQUIPMENT**

1. **UPS SYSTEM**
   - Emerson/3 M Power / SOCOMAC
2. **INVERTER**
   - Luminous / Microtek / SU-KAM

**B. ELECTRICAL SYSTEM/PANELS**

1. **FUSES & SWITCH FUSE UNIT**
   - L&T/ABB/SCHNEIDER/GE
2. **ACB/MCCB/CONTACTOR**
   - L&T/ABB/SCHNEIDER/GE
3. **METAL CLAD SOCKET**
   - Siemens/MDS/Bhartia Cutlur Hammer
4. **RISING MAINS/BUS DUCT**
   - ABB/SPC ELECTROTECH/SCHNEIDER
5. **LED'S LIGHT**
   - Philips/Wipro/Bajaj
6. **ISOLATORS FOR MOTORS**
   - MDS/Siemens/Schneider/ABB/GE
7. **CHANGE OVER SWITCH**
   - HH-Elcon/HPL SOCOMAC/GE
8. **CONTACTOR, TIMER, SINGLE PHASE PREVENTOR & OVER LOAD RELAY**
   - L&T/ABB/SCHNEIDER/GE
9. **METERS - DIGITAL TYPE**
   - AE/L&T/Rishab/GE
10. **PROTECTIVE & APFC RELAYS**
    - Asltom/Ashida/L&T
11. **CT's / PT's- DRY TYPE-EPOXY**
    - AE/Kappa
12. **INDICATING LAMP/PUSH BUTTON ACTUATERS - LED CLUSTER TYPE**
    - L&T/Siemens/BCH
13. **ROTARY SWITCHES**
    - L&T/Kaycee/BCH
14. **TERMINAL BLOCK**
    - Elemex/Wago
15. **LT PANELS**
    - Tricolite Industries / SPC Electrotech / Adlec / Schneider Electric / C&S / ABB
16. **LIGHTNING ARRESTER**
    - ERICO/ESE
17. **GAS FIRE SUSPERSION SYSTEM**
    - Fire Line/Tyco Fire
## C. CABLES/ TERMINATIONS/ ACCESSORIES

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<td>BRASS CABLE GLANDS</td>
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<td>LT POWER CABLE (ALUMINIUM/ COPPER)</td>
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<td>CONTROL CABLE (COPPER)</td>
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<td>6</td>
<td>H.T. CABLE END TERMINATION</td>
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<td>7</td>
<td>Fire Survival Cable</td>
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## D. CONDUITING & WIRING ACCESSORIES

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<tr>
<td>1</td>
<td>MS CONDUIT / GI CONDUIT (ISI MARKED)</td>
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<td>PVC CONDUIT (ISI MARKED)</td>
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<td>3</td>
<td>PVC INSULATED COPPER CONDUCTOR FRLS WIRE</td>
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<td>PLATE TYPE - SWITCHES / SOCKETS / TV &amp; TELEPHONE SOCKETS AND ALL OTHER WIRING ACCESSORIES</td>
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<td>5</td>
<td>ACCESSORIES FOR METALIC / GI CONDUIT ( ISI MARKED )</td>
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<td>PVC INSULATION TAPE</td>
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<td>7</td>
<td>PHENOL LAMINATED SHEET</td>
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<td>RACEWAYS &amp; CABLE TRAY</td>
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## E. LIGHTING DBs & MCBs

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<td>ELCB / ELMCB / RCCB</td>
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## F. LIGHTING FIXTURES & FANS

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<td>EXHAUST FANS / CEILING FAN / WALL MOUNTED FAN</td>
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<td>LIGHTING FIXTURES</td>
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<tr>
<td>4</td>
<td>LIGHTING CONTROL SYSTEM</td>
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## G. ELV- TELEPHONE/ CCTV/ DOOR ACCESS/ FIRE ALARM/ PUBLIC ADDRESS & MISC. SYSTEMS

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<td>Hooter/ Sounder</td>
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<td>Road Barrier</td>
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<td>IT &amp; Telecom System</td>
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<td>Fire Alarm System</td>
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<td>Access Control System</td>
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<td>Fire Survival Cable</td>
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<td>Ceiling mounting kit for projector</td>
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<td>32</td>
<td>Fixed Screen</td>
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<td><strong>H. MISCELLANEOUS SYSTEMS</strong></td>
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<tr>
<td>1</td>
<td>Batteries</td>
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<td>Battery Charger</td>
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<td>Earthing (All Type)</td>
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<td><strong>I. DG/PANEL/TRANSFORMER</strong></td>
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<td>ALTERNATOR</td>
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<td>ENGINE</td>
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<td>HT PANELS</td>
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<td>TRANSFORMER</td>
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<td>UNITISED / COMPACT SUB-STATION</td>
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**PLUMBING SYSTEM**

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<thead>
<tr>
<th></th>
<th>VITREOUS CHINA SANITARYWARE</th>
<th>PARRYWARE, ROCA, HINDWARE / JAQUAR</th>
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<tbody>
<tr>
<td>2</td>
<td>PLASTIC W.C.SEATS &amp; COVERS</td>
<td>PARRYWARE, ROCA, HINDWARE / JAQUAR</td>
</tr>
<tr>
<td>3</td>
<td>C.P. FITTINGS: BIB COCK (LONG BODY/SHORT BODY), PILLAR COCK, SINGLE HOLE BASIN MIXTURE, WALL MIXER, SHOWER MIXER, ANGLE VALVE, CONCEALED STOP COCK, SHOWER WITH WALL FLANGE, C.P. WASTE 32-40 mm DIA, BOTTLE TRAP, HEALTH FAUCET WITH STEEL BEDED CONNECTING PIPE.</td>
<td>JAQUAR / ESS ESS / GROHE / HINDWARE / PARKO / PLAYER</td>
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<tr>
<td>4</td>
<td>AUTOMATIC WATER TAPS, AUTOMATIC URINAL FLUSHING SYSTEM</td>
<td>JAQUAR / ESS ESS / GROHE / HINDWARE / PARKO / PLAYER</td>
</tr>
<tr>
<td>5</td>
<td>TOWEL RING, TOWEL ROD, TOWEL RACK, COAT HOOK etc. (304 Grade S.S.)</td>
<td>JAQUAR / ESS ESS / GROHE / HINDWARE / PARKO / PLAYER</td>
</tr>
<tr>
<td>6</td>
<td>CHROMIUM PLATED / STAINLESS STEEL / POLY VENIEL CHLORIDE GRATING</td>
<td>Cummun, Neer, Chilly</td>
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<td>7</td>
<td>STAINLESS STEEL SINK</td>
<td>JAINA / NEELKANT/ ANUPAM</td>
</tr>
<tr>
<td>8</td>
<td>SAND CAST IRON SPUN PIPE, CENTIFUGALLY CASTED S &amp; S AS PER IS: 3989</td>
<td>NECO / RAJ IRON FOUNDRY / RIF/SKF</td>
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<tr>
<td>9</td>
<td>CAST IRON PIPE, HORIZONTALLY / VERTICALLY CASTED S &amp; S AS PER IS: 1729</td>
<td>NECO / RAJ IRON FOUNDRY / RIF/SKF</td>
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<td>10</td>
<td>G.I. &amp; M.S. PIPES PART-I IS: 1239 UPTO 150 mm AND M.S. PIPES PART-II IS: 3589 ABOVE 150 mm</td>
<td>TATA STEEL (TUBE DIVISION)/ JINDAL PIPES LIMITED</td>
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<td>11</td>
<td>G.I. AND M.S. FITTINGS</td>
<td>UNIQUE./ ZOLOTO / KENT</td>
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<td>12</td>
<td>uPVC PIPES &amp; FITTINGS 4 kg./sqm, 6 kg./sqm, 10 kg./sqm PRESSURE.</td>
<td>SUPREME INDUSTRIES LIMITED/ FINOLEX INDUSTRIES/ PRINCE PIPES &amp; FITTINGS PRIVATE LIMITED</td>
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<td>cPVC PIPES SDR12.5 SCHEDULE-40</td>
<td>ASTRAL POLYTECHNIC PRIVATE LIMITED/ ASHIRVAD ENTERPRISES PRIVATE LIMITED/ JAIN PLASTICS &amp; CHEMICALS LIMITED / FINOLEX INDUSTRIES</td>
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<td>HDPE PIPE</td>
<td>JAIN PLASTICS &amp; CHEMICALS LIMITED/ CHEMI PLAST INDUSTRIES STUROY POLYMERS LIMITED/ KISAN GROUP OF COMPANIES / FINOLEX INDUSTRIES</td>
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<td>C.I.CLASS LA PIPES</td>
<td>KESORMA SPUN PIPE &amp; FOUNDRIES, CALCUTTA/ SUPER ENTERPRISES/ INDIAN IRON &amp; CO. LTD. CALCUTTA.</td>
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<td>16</td>
<td>R.C.C. PIPES</td>
<td>PRAGATI CONCRETE UDYOG/ K.K. SPUN PIPES/ J. K. SPUN PIPES/ SOOD &amp; SOOD</td>
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<td>17</td>
<td>STONEWARE PIPES &amp; GULLY TRAP</td>
<td>DEVRAJ ANAND CERAMIC (P) LIMITED./ PERFECT POTTERI JABAL PUR (MP)/ BURN POTTERIES, JABALPUR</td>
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<td>18</td>
<td>GUNMETAL VALVES(FULLWAY, CHECK, GLOBE AND NON RETURN VALVES)</td>
<td>LEADER VALVES LIMITED/ ARKAY SALSE CORPORATION DELHI</td>
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<td>19</td>
<td>BALL VALVE</td>
<td>TBS ENGINEERS PVT. LTD./ VIRGO ENGINEERING LTD./ GOOJARMAL GANPATRAI/ AUDCO INDIA LIMITED</td>
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<tr>
<td>20</td>
<td>BUTTERFLY VALVE (LEVER TYPE)</td>
<td>LEADER VALVES LIMITED/ CASTLE VALVES LIMITED/ AUDCO INDIA LIMITED</td>
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<tr>
<td>21</td>
<td>BUTTERFLY VALVE (GEAR TYPE)</td>
<td>LEADER VALVES LIMITED/ CASTLE VALVES LIMITED/ AUDCO INDIA LIMITED/ GOOJARMAL GANPATRAI</td>
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<tr>
<td>22</td>
<td>C.I.DOUBLE FLANGED SLUICE VALVE &amp; GATE VALVES</td>
<td>KIRLOSKAR BROTHERS LIMITED/ AARKO MANUFACTURING COMPANY/ ARROW ENGG.LTD</td>
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<td>23</td>
<td>FLOAT VALVE (GUNMETAL) UPTO 40M</td>
<td>SANT INDUSTRIAL CONTROLS (P) LIMITED/ BOMBAY METAL &amp; ALLOYS/ LEADER VALVES LIMITED</td>
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<td>24</td>
<td>FLOAT VALVE (CI) 50M AND ABOVE</td>
<td>LEADER VALVES LIMITED/ INDIAN VALVE CO. LTD.</td>
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<td>25</td>
<td>FOOT VALVE / CHECK VALVES (BRASS)</td>
<td>LEADER VALVES LIMITED/ INDIAN VALVE CO. LTD./ CALCUTTA/ ADVANCE VALVES (P) LIMITED/ GOOJARMAL GANPATRAI/ AARKO MANUFACTURING COMPANY</td>
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<td>26</td>
<td>AIR RELEASE VALVES (BRASS / CAST IRON)</td>
<td>LEADER VALVES LIMITED/ ADVANCE VALVES (P) LIMITED/ AARKO MANUFACTURING COMPANY/ GOOJARMAL GANPATRAI</td>
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<td>27</td>
<td>C.I. MANHOLES COVER &amp; G.I. GRATING</td>
<td>K. K. MANHOLE &amp; GRATING CO. PRIVATE LIMITED/ BANGLAL IRON COMPANY WEST BANGAL/ SHINING ENGINEERING WORKS (FOUNDRY) AGRA.</td>
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<td>28</td>
<td>HAND DRIER (304 Grade S.S.)</td>
<td>THE VEERA TRADING COMPANY/ KOPAL ENGG. CORPN.NEW DELHI/ ASKON ENGINEERS BOMBAY</td>
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<td>29</td>
<td>LIQUID SOAP DISPENSER (304 Grade S.S.)</td>
<td>THE VEERA TRADING COMPANY/ ASKON ENGINEERS BOMBAY</td>
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<td>STORAGE TYPE WATER HEATER</td>
<td>VENUS / RACOLD/BAJAJ OR EQUIVALENT</td>
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<td>THERMAFLEX OR EQUIVALENT</td>
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<td>VENUS/ KINGSTON</td>
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<td>PVC FOOT REST &amp; SFRC COVERS</td>
<td>KK MANHOLES OR EQUIVALENT</td>
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**PUMPS AND EQUIPMENTS**

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<td>ABB/ GROUNDFOS/ KIRLOSKAR/ SIEMENS/ CROMPTON</td>
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<td>GROUNDFOS/ KIRLOSKAR</td>
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<td>SUMP PUMP</td>
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<td>ADVANCE OR EQUIVALENT</td>
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<td>ASIA LMI Pvt. Ltd/ TOSHNIWAL</td>
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<td>WATER METER</td>
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<td>SOUNDER PATTERN VALVE FOR FILTER AND SOFTENER</td>
<td>LABLINE/ AIP (AGRICULTURE AND INDUSTRIAL PUMPS.</td>
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<td>MOTORIZED VALVE</td>
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**Note:** Contractors have to take approval from Engineer in charge / Consultants before placing of order of any required materials from the above mentioned approved makes. If any required materials (as per BOQ / Extra items) not available in above list Engineer in charge /Consultants can add the make / Brand in list at any stage, decision will be final and binding on contractors. If any doubt about listed makes / Brand Engineer in charge may amend the list at any stage, decision will be final and binding on contractors.
ELECTRICAL WORK TENDER DOCUMENT
(R 1-14.07.15)

VOLUME-I

TECHNICAL & SPECIFICATION
PROPOSED CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL AT SUNDERGARH, ODISHA

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INSTRUCTION & SPECIAL CONDITIONS FOR SUBMISSION OF TENDER

SUBJECT: Proposed Electrical Work for Medical College & Hospital at Sundergarh, Odisha.


a) Supply of D.G. Set
b) Installation of D.G. Set.
c) Bus Duct / Cabling
d) D.G. Set Aux. Panel.
e) Earthing System.
f) D.G. Set Exhaust Piping
g) Safety Equipment
h) SIT&C of 33KV/0.415KV Substation
i) Synchronizing Panels
j) Main L.T. Panels
k) Bus Duct
l) Floor Distribution Panel
m) Distribution Boards
n) Main & Sub main Cables
o) Point Wiring
p) Light Fixtures
q) Telephone System
r) Data cabling Network
s) Addressable Fire Detection System
t) Public Address System
u) CCTV System
v) Lightning Protection System
w) UPS System
x) Access Control System
y) External Lighting
z) All other item as detailed in Schedule of Quantities.

1.1 GENERAL:
A) This specification covers manufacturer, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installation, final testing, commissioning, putting into operation including one year guarantee period for the following Work.

B) Name of Work : Electrical Work

C) The work shall be executed as per CPWD General Specifications as amended up to date, relevant IE rules, relevant IS and as per directions of Engineer-in-Charge. These additional specifications & conditions are to be read in conjunction with above and in case of variations; specifications given in the Additional Specifications & Conditions shall apply. However, nothing extra shall be paid on account of these as the same are to be read along with schedule of quantities for the work.

1.2 COMMERCIAL CONDITIONS:

1.2.1 TYPE OF CONTRACT:
The work to be awarded by this tender shall be treated as individual works contract.

1.2.2 SUBMISSION & OPENING OF TENDER:
The tender is in two parts:

Part I- Technical cum Commercial Bid.
Part II- Price Bid.

1.2.2.1 Tender documents will be issued to only those applicants who are considered to meet the pre-qualification criteria as per press notice by the competent authority.

1.2.2.2 The tender shall be submitted duly completed in two separate sealed envelopes, one for Part-I Technical and Commercial Bid, and the other Part-II Price Bid. Both these bids shall be submitted together on or before the due date and time. The name of the work, “Technical-cum- Commercial Bid only” / “Price Bid only” shall clearly be super scribed on the top of the respective sealed envelopes.

1.2.2.3 The Part-I Technical cum Commercial Bid shall be submitted complete with the following documents

a) Complete tender documents (Part-I) in original, as purchased from CPWD including the schedule of work (without indicting the price) duly signed for acceptance of all terms and conditions:
b) An undertaking that the contractor will deposit earnest money amounting to Rs.-----
--------------------------------- at the time of opening of price bid.

c) Deviation, if any from NIT specifications should be clearly brought out.

d) Complete Technical Particulars of all equipments & materials as per performa.

e) Technical literature & catalogues of all equipments.

1.2.2.4 Part- II Price Bid shall contain the following

Price Bid Part-II of the tender in original as issued by the department duly filled in and
signed by the tenderer.

1.2.2.5 The tenderers are advised not to deviate from the technical specifications/ items,
commercial terms and conditions of NIT like terms of payment, guarantee, arbitration
clause, escalation etc.

1.2.2.6 The tenderers will have to fill up their rates and amounts in figures as well as words in the
Price Bid (Part-II of tenders) issued by the department. Tenders in which the Price Bids
are given in any other format are liable to be rejected. The abstract of cost will be required
to be filled in.

1.2.2.7 The Technical cum Commercial Bid only, shall be opened first on the due date and time,
as specified in form CPWD-6, in the presence of tenderers or their authorized
representatives who wish to remain present. The price bids of those tenderers whose
technical-cum-commercial bids are found acceptable shall be opened on the date and time
to be specified subsequently.

1.2.2.8 Scrutiny evaluation of the Technical-cum-Commercial Bid shall be done by the department
in consultation with any agency as deemed necessary. In case it is found that the
Technical-cum-Commercial Bid of a tender is not in line with NIT specifications,
requirements and / or contains many deviations, the department reserves the right to
reject the Technical Bid of such firm(s) without making any reference.

1.2.2.9 Necessary clarifications required by the department shall have to be furnished by the
tenderer within the time given by the department for the same. The tenderer will have to
depute his representative to discuss with the officer(s) of the department as and when so
desired. In case, in the opinion of the department a tenderer is taking undue long time in
furnishing the desired clarifications, his bid will be rejected without making any reference.

1.2.2.10 After obtaining clarifications from all the tenderers, the department may modify the
technical and commercial conditions / specifications if required, and will intimated the
tenderers whose technical cum commercial bids are acceptable.

1.2.2.11 Revised Price Bids, if required, due to changes in the tendered specifications, terms and/or
conditions shall be given in a sealed envelope suitable super scribed with the name of
the work and the words, “Revised Price Bid” by the tenderers before the stipulated date
and time.

1.2.2.12 In the Price Bid, there shall be no conditions whatsoever. In case any tenderer mentions
any condition including conditional rebate in their price part, tender shall be rejected
forthwith.

A tenderer will not be allowed to withdraw or modify any condition at a time after the
technical bids have been accepted and the decision to open the price has been taken by
the department.
1.2.2.13 The Part – II of the tender i.e. Price Bid of the tenderers whose Technical-cum-Commercial Bids have been accepted, will be opened by the Executive Engineer (E) in the presence of the representatives of the tenderers who wish to be present. The Price Bids of only tenderers will be opened who have submitted the earnest money amounting to Rs. --- in prescribed manner. EMD should be in shape of DD or pay order of a scheduled/nationalized bank guaranteed by RBI and drawn in favour of ---.

The tenderers who do not deposit the earnest money or the earnest money deposited by them is not in order, their Price Bids will not be opened.

1.2.2.14 The department reserves the right to reject any or all the price bids and call for fresh prices / tenders as the case may be without assigning any reason.

1.2.2.15 The department reserves the right to award the work in full or parts dividing amongst tenderers as found suitable by the competent authority.

1.3 GUARANTEE:

All equipments shall be guaranteed for a period of 12 months from the date of acceptance and taking over of the installation by the Department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-charge in this regard shall be final.

1.4 PAYMENT TERMS:

1.4.1 MOBILISATION ADVANCE:

The Contract value for calculating the mobilization advance, shall be taken as Rs.---Lac. The CONTRACTOR shall be paid Mobilisation Advance as follow:-

i) 5% of contract value shall be paid within one week of submission of the bank guarantee, in approved performa, for the equivalent amount.

ii) 5% of contract value shall be paid after approval of shop drawing and technical submittals.

The mobilization advance shall be recovered from CONTRACTOR’S Bills on pro-rata basis in such a way that the whole amount is recovered when 90% of the job gets paid i.e. 11.2% in each Bill.

1.4.2 RETENTION MONEY/SECURITY DEPOSIT:

Retention Money / Security Deposit at the rate of 5% of the value of the work done shall be deducted from RA Bills, subject to a maximum limit of Rs.---/- (Rupees --- only). The Earnest Money Deposit shall be accounted for in the Security Deposit. The Security Deposit amount shall be released on successful completion of one year of the Defect Liability Period.

1.4.3 EXTRA ITEM/ADDITIONAL ITEM:

The rates for any extra items/additional works under this contract agreement shall be fixed as under:
PROPOSED CONSTRUCTION OF MEDICAL COLLEGE & HOSPITAL AT SUNDERGARH, ODISHA

a) In case similar item exists in the Bill of Quantities, then the same rates shall be adopted and paid.

b) If no such similar item exists, then the rate shall be based as per the actual cost of materials (excluding cost of materials being supplied by OWNER to be incorporated into works) and reasonable labour and 10% contractors profit and overhead.

1.4.4 WATER & ELECTRICITY:

Water & Electricity shall be supplied free of cost by the owner at one point only.

Any further distribution shall be arranged by the CONTRACTOR at his own cost. The Electricity shall be used for project only and not for any other purpose i.e. fabrication of shuttering plates etc.

The supplies shall be limited to the time & quantum as supplied by State Electricity Board / Local Authority.

In the event of breakdown of Power Supply from State Electricity Board, the CONTRACTOR shall make adequate suitable alternative arrangements of dieselized equipment & diesel generating set at his own cost to keep up the Schedule of completion. Nothing extra shall be payable on this account, and such causes, shall not be accounted for delays in completion of works.

1.4.5 PAYMENTS IN R.A. BILLS:

The ENGINEER-IN-CHARGE is authorized to make part rate payments for the work executed / measured in R.A Bills related to the stages of items of work done.

1) 65% on receipt of material at site as per items rates.
2) 15% after installation is carried out.
3) 15% after testing & commissioning.
4) 5% after handing over and submission of as built drawings and maintenance manuals.

NOTE: The Performa for Bank Guarantees shall be as approved by OWNERS.

1.5 VALIDITY:

The tender shall be valid for acceptance for a period of 90 days from the date of submission of the tender.

1.6 COMPLETION PERIOD:

The completion period shall be -------------------Month from the date of Letter of Intent.

1.7 SHOP DRAWING:

On the award of the work, the Contractor shall immediately proceed with the preparation of detailed working drawings showing the detail of each equipment that are to be installed and the associated works that are to be carried out. All the works are deemed to be included in various items of bill of quantities as applicable.

Three sets of all such working drawings duly signed by the head of the planning & design department of the tenderer shall be submitted to the consultants / Engineer-in-charge for approval to ensure that the works will be carried out in accordance with the specifications and
drawings, including such changes as may have been mutually agreed upon. All the drawings shall be received by the Consultants/Engineer-in-charge for approval within 04 (Four) weeks from the date of award of work. The approval of the drawings by the Consultants/Engineer-in-charge shall in no way relieve the Contractor from his obligations to provide a complete and satisfactory plant installation, testing and commissioning as per intent and purpose as laid down in the specifications.

Any omissions and/or errors shall be made good or rectified whether or not the drawings are approved. Contractor shall obtain written approval for samples as cable tray, cable tag, and other materials before placing the order.

The Contractor shall also fix operation schedule chart, in the Operating/Maintenance Room, neatly typed and framed, instructions in details, for the starting and running of the electrical equipment.

The shop drawings shall be prepared by the electrical contractor based on GFC Drawing approval of Architect/Consultant.

The all equipment manufacturing drawings shall be prepared by the electrical contractor/manufacturer for approval of Architect/Consultant.

1.8 AS BUILT DRAWING:

At the completion of work and before issuance of certificate of virtual completion the contractor shall submit three (04) sets to the Engineer-in-charge, layout drawing drawn at appropriate scale indicating the complete Electrical System “as installed”.

1.9 INSTRUCTION/Maintenance MANUAL:

The Contractor shall prepare and produce instruction, operation and maintenance manuals in English for use, operation and the maintenance of the supplied equipment and installations, and submit to the Engineer-in-charge in three copies at the time of handing over. The manual shall generally consist of the following:

a) Description of the Project.
b) Operating instructions.
c) Maintenance instructions including procedures for preventive maintenance.
d) Manufacturers catalogues.
e) Spare parts list.
f) Trouble shooting charts.
g) Drawings.
h) Type and routine test certificates of major items.
i) One (1) set of reproducible ‘as built’ drawings.

1.10 PRICES, UNIT RATES & TAXES / DUTIES ETC:

a) The prices and unit rates quoted by the bidder in the bid shall be firm and deem to be adequate to cover the entire responsibility involved in the execution and completion of work. The rates shall be complete in all respects including cost of materials, erection, fabrication, labour, supervision, tools and plant, transport, contingencies, breakage, wastage, sundries, scaffoldings, insurance & all government levies such as excise, sales tax, WCT, VAT, SERVICE TAX etc.

b) The contract value shall be inclusive of custom duty, CVD etc on Imported Equipments & also inclusive of excise duty & inclusive of VAT/ local sales tax on indigenous Equipments/Materials and inclusive of octroi duty or any other duties or fees levied by government or any public or local bodies.
c) The contract value shall remain firm during the currency of the contract and shall be subject to statutory variation in sales tax on works contract or on rate of custom duty / excise duty applicable on refrigeration equipments only. In case assessable values are increased by the manufacturer of refrigeration equipment during the currency of contract, the client shall not pay any increase in quantum of excise duty on account of change in assessable value. No increase in prices due to change of rate of excise duty on bought all items shall be paid. No increase due to change in daily wages of labour be paid, due to any reasons whatsoever.

d) The total contract price quoted by the bidders shall be inclusive of works contract / turnover tax if applicable & shall be deducted by the Client at source & certificate shall be issued for the same. The works contract price quoted shall remain firm till completion of job and handing over the same in working condition to the client.

e) The price should not be changed subject to exchange rate variations.

f) The rates quoted shall be deemed to allow for all minor extras and constructional details, which are not specifically shown on drawings or given in the specifications but are essential in the opinion of the Engineer-In-charge for the execution of works to con-form to good workmanship and sound engineering practice.

g) The Engineer-In-charge decision to clarify any item under minor changes, minor extras and constructional details shall be final, conclusive and binding on the Contractor.

h) The rates quoted by the Contractor shall be net so as to include all the requirements described in the contract agreement and no claim whatsoever due to fluctuations in the price of materials and labour will be entertained.

i) In case the rates of identical items under different sub-heads / parts are different, the lowest of these will be taken for the purpose of making the payments.

j) The contractor shall provide all equipments, instruments, labour and such other assistance required by the Engineer-in-charge for measurement of the works, materials etc.

1.11 VARIATION IN QUANTITIES & TENDER DRAWINGS:

The quantities for ancillary works given in the schedule and / or in drawings are for the guidance of the tenderer. The contractor shall be paid on the basis of actual quantities of works carried out. However the contractor shall check these quantities before quoting and will bring to the notice of Consultants / Engineer-In-charge for any major variation. Drawing issued with the tender are diagrammatic only and indicate the general arrangement only. The data given in the drawings and specifications is as exact as could be secured, but its accuracy is not guaranteed. The contract shall be on works contract basis and the Client reserves the right to add / delete any items of work during the currency of contract.

1.12 PERFORMANCE BOUND CONTRACT:

The contract will be a performance bound contract. The drawings enclosed with the tender documents shall be only tentative layout plans and for guidance purpose only. The detailed shop drawings shall be prepared and submitted for approval to the Client / Consultant. The contractor shall guarantee that the capacity of various components.

1.13 REPAIRS / REPLACEMENT OF PARTS DURING GUAURANTEE:

Any defects or other faults which may appear within defect liability / guarantee period of twelve months from the date of handing over the system in a satisfactory working conditions to the Client (except for normal wear and tear) arising in the plant from material or
workmanship not in accordance with the contract specification will be rectified by the contractors free of cost & nothing shall be paid extra on any account.

1.14 **TESTING:**

All testing instruments, Meggar, Current Clamp Tester, Multimeter, digital / electronic electric energy meter, equipment for D.G. Set & Cooling Tower testing, tools, scaffolding and ladders etc, that may be required for taking measurements shall be arranged by electrical contractor at his own cost.

All types of specified & routine tests of the equipments shall be carried out at the works of the Contractor or the manufacturers of the components. The Client shall be free to witness any or all tests, if they so desired. The Contractor has to inform to the Client before dispatch of any material / equipment.

On the completion of the installation the Contractor shall arrange to carry out various initial tests as detailed below, in the presence of and to the complete satisfaction of the Consultants or his representative / Engineer-In-charge, any defect or short-coming found during the tests shall be speedily rectified or made good by the Contractor at his own expenses. The initial tests shall include, but, not be limited to the following:

a. To operate and check proper functioning of all equipment.

b. To test and check the proper functioning of all equipment, electrical switchgears, safety and other controls to ensure their proper functioning.

c. To check & set the all relay as per design data.

d. Contractor shall have to submit the capacity test of all equipment at site.

e. On the satisfactory completion of all ‘Initial’ tests the plant shall be considered ‘Virtually Complete’ for the purpose of taking over by the Client & balance payment shall be released against BG.

It is clarified that guarantee period shall start after successful completion of commissioning & handing over.

1.15 **TRAINING OF PERSONAL:**

The contractor shall impart training to the minimum three technical staffs appointed by the Department free of cost during erection and commissioning of the plant.

1.16 **INSPECTIONS & TESTING:**

All the major equipments may be got inspected & tested before dispatch if desired by the client at the manufacturers work.

The Contractor shall intimate to the Department minimum 10 days in advance about the date of readiness of equipment for inspection & testing at a date to be mutually agreed upon by the client & the Contractor.

The manufacturer of these equipments must have a facility of testing the equipments at the test bed on full load at their works. All the test readings mutually taken shall be recorded & evaluated with the technical data furnished by the Contractor.

1.17 **STORAGE OF MATERIAL / EQUIPMENT:**

The Site office, Storage Yards etc. and the labour camps shall be established by the CONTRACTOR outside site premises.
1.18 **LIASIONING WORK:**

Liasioning Work with Government Authority for Single Line Diagram & Complete Electrical Installation approval from CEI shall be done by contractor. All the expenses shall be borne by contractor.

1.19 **CONTRACT AGREEMENT:**

The successful bidders shall prepare agreement on stamped paper within ONE WEEK from the date of Letter of Intent. Four copies of the agreement duly bound shall be prepared at successful bidder’s cost & shall be submitted to consultant / engineer in charge for approval.

The following documents shall constitute the contract agreement:

a) Invitation to tenders.

b) Special conditions of the contract, tender document, drawings.

c) Complete correspondence between the successful bidder and the Client / Consultant shall be consolidated in one letter by the bidder which shall form part of the contract agreement.

d) Any other documents necessary for completion of contract agreement.

1.20 **INSURANCE:**

The contractor shall be responsible for the storage and safe custody of all equipment / materials brought to site from time to time till the plant is taken over by the department. The contractor may provide adequate and comprehensive insurance coverage for storage and execution.

The contractor shall be responsible for any injury or damage to persons, buildings, structures, property etc., which may arise from any act of omission on part of the contractor or his servants or sub contractors or his employee etc. The contractor shall indemnify and keep indemnified the owner and hold him harmless in all respects of all and any expenditure liability, loss, claims or proceeding arising from any such injury or damage to persons or property as aforesaid.

The contractor may undertake all risk policy including earthquake risk with an insurance company approved by the owner in the joint names of owner and contractor at his own expense.

1.21 **ARBITRATION:**

Any disputes or difference arising out of, from or relating to anything contained in the resulting document, shall be referred to the sole arbitration of Client. The award made by the sole arbitrator shall be binding on the parties hereto. Such arbitration shall be governed by the provisions of the Arbitration Conciliation Act, 1996 or any statutory modification or re-enactment thereof of the being in force. The venue of the arbitration shall be Bhubaneshwar.

1.22 **FORCE MAJEURE:**

In the event that the Contractor / vendor or any of its subcontractors or the Purchaser is delayed in performing any of their respective obligations under the Contract, and such delay is caused by Force Majeure, including but not limited to war, civil insurrection, fires, floods, epidemics, earthquakes, quarantine restrictions and freight embargoes, such delay may be
excused as provided in Article 12 and the period of such delay may be added to the time of performance of the obligation delayed.

If a Force Majeure situation arises, the Contractor / vendor shall promptly notify the Purchaser in writing of such condition and the cause thereof. Unless otherwise directed by the Purchaser in writing, the Contractor / vendor shall continue to perform its obligations under the Contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.

1.23 **LABOUR LAW AND SAFETY REGULATION:**

The Contractor will be required to make good for any damage caused during the awarded work. Any injury / casualty to any skilled / unskilled worker during the work execution will be the entire responsibility of the Supplier / Vendor and your labour should be duly insured.

Contractor will be responsible for the compliance of the provisions of the various labour laws (status) applicable to workmen deployed by the contractor party in relation with the subject services. Following rules / regulations may be concerned in particular.

- Payment of Wages Act, 1936.
- Contractor Labour (Regulation and Abolition Act), 1970.
- Payment of Bonus Act, 1965.
- The Workmen’s Compensation Act, 1923.

**END OF SECTION – 01**
2 BASIS OF DESIGN

2.1 SITE LOCATION
SUNDERGARH, ODISHA

2.2 INTRODUCTION
A centralised electrical system shall be designed, installed & commissioned to provide the electrical power for Medical College & Hospital at Sundergarh, Odisha.

2.3 OUTSIDE DESIGN CONDITION

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<tr>
<td>Minimum</td>
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<tr>
<td>Maximum</td>
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</table>

2.4 LOCATION OF D.G. SET & SUBSTATION:
D.G. Set shall be installed on Ground Floor Level as per drawing attached.

2.5 CAPACITY OF D.G. SET:
2x1000 KVA + 1x600 KVA, 415 Volt radiator cooled D.G. Set with acoustic enclosure shall be installed on Ground Floor Level to provide the power backup as per requirement in case of power cut / break down of Grid Supply.

2.6 CAPACITY OF 33KV / 0.415KV SUBSTATION:
3x1750 KVA, 33KV/0.415KV, 3 Phase, 4 Wire, 50 Hz, Oil type transformer with on load tap changer shall be installed on Ground Floor Level to provide the power to entire complex with required H.T. Panel etc.

2.7 STARTING METHOD FOR D.G. SET:
D.G. set shall be suitable for Manual/Auto start through D.G. Set Controller and shall be compatible for synchronizing through Synchronizing relay.

2.8 D.G. COOLING METHOD:
D.G. Set shall be radiator cooled.

2.9 EARTHING SYSTEM:
The earthing system to be provided for the D.G. set system as required as per IS: 3048.

2.10 D.G. SYNCHRONIZING PANEL:
D.G. Synchronizing Panel shall be installed in D.G. Room for synchronization of D.G. Sets.

2.11 Main L.T. PANEL:
Main L.T. Panel to be installed in D.G. Room for changeover the power and power distribution for entire building.

2.12 CAPACITOR PANEL:
Capacitor Panel to be installed to improve the power factor as per norms of SEB.
## 2.13 ELECTRICAL LOAD CALCULATION: (FOR 33KV/0.415KV SUBSTATION)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>DESCRIPTION</th>
<th>AREA (SMT)</th>
<th>UNI T</th>
<th>TOTAL CONNECTED LOAD (GRID)</th>
<th>TOTAL CONNECTED LOAD (D.G. BACKUP)</th>
<th>TOTAL DEMAND LOAD (FOR GRID SUPPLY)</th>
<th>DAY LOAD</th>
<th>NIGHT LOAD</th>
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**OVERALL DIVERSITY**: 0.8
**DEMAND LOAD**: 2214

A) DEMAND LOAD FOR NORMAL SUPPLY (F+G) **KW**: 3591

B) DEMAND LOAD FOR EMERGENCY SUPPLY (G) **KW**: 1701

1) TRANSFORMER RATING

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**3 X 1750 KVA, 33/0.415 KV, OIL TYPE TRANSFORMER WITH ON LOAD TAP CHANGER**
### Proposed Construction of Medical College & Hospital at Sundergarh, Odisha

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<th>S. No.</th>
<th>DESCRIPTION</th>
<th>AREA (SMT)</th>
<th>UNIT</th>
<th>TOTAL CONNECTED LOAD (GRID)</th>
<th>TOTAL CONNECTED LOAD (D.G. BACKUP)</th>
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2 x 1010 KVA + 1 x 600 KVA, 415 VOLT, RADIATOR COOLED D.G. SET
3 TECHNICAL SPECIFICATION OF EQUIPMENTS

3.1 CABLE WORK

3.1.1 DESCRIPTION OF WORK
Supply, laying, testing and commissioning of cables as per specifications, schedule of quantities and drawings.

3.1.2 APPLICABLE CODES & STANDARDS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>IS: 10242 (Part-3, Section-12)</td>
<td>Installation of cables for low voltage System</td>
</tr>
<tr>
<td>IS: 7098 (Part-1&amp;2)/IS: 5831/IEC: 60502/BS: 6746/BS:5467</td>
<td>Cross linked polyethylene insulated PVC sheathed cables. Part-I: For working voltages up to &amp; including 1100 Volts. Part-II: For working voltage from 3.3 KV up to &amp; including 33 KV.</td>
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<tr>
<td>IS: 10810</td>
<td>Method of test for cables</td>
</tr>
<tr>
<td>IS: 1255</td>
<td>Code of practice for installation &amp; maintenance of power cables up to &amp; including 33 KV rating.</td>
</tr>
<tr>
<td>IS: 8130/IEC: 60228</td>
<td>Conductors for cables</td>
</tr>
<tr>
<td>IS: 10418</td>
<td>Drums for electric cables.</td>
</tr>
<tr>
<td>IS: 2062, IS: 800, IS: 816</td>
<td>Structural wedding steel</td>
</tr>
</tbody>
</table>

3.1.3 SUBMITTALS
Cable schedule as per site conditions & good for construction drawings.

Layout of various cables on cable tray / trench along with sections showing no. of cables, distance between cables etc, size of cable trays etc.

Cable tray layout, as per site condition, duly coordinated with other services.

3.1.4 TEST REPORTS
Routine test certificates for each drum of cable brought to site.

3.1.5 SPECIFICATIONS

GENERAL
Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

MATERIAL
The MV power cable of 1100 V. grade shall be FRLS Aluminium conductor armoured cable as per relevant IS.
The MV control cables shall be PVC insulated copper conductor armoured cable.
The HT power cable of 33 KV grade shall be XLPE insulated Aluminium conductor armoured cable.

3.1.6 INSTALLATION

GENERAL

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S. 1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Engineer-in-Charge.

3.1.7 PROXIMITY TO COMUNICATION CABLES

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 30 cm.

3.1.8 CABLE LAYING DIRECT IN GROUND

GENERAL

This method shall be adopted where the cable route is through open country along roads/lanes etc. and where no frequent excavation are encountered and where excavation is easily possible without affecting other services.

TRENCHING

WIDTH OF TRENCH: - The width of trench shall be determined on the following basis:

a) The minimum width of trench for laying single cable shall be 35 cm.

b) 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 inter-axial spacing between the cables, except where otherwise specified shall be at least 20 cm.

c) There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

DEPTH OF TRENCH: - The depth of trench shall be determined on the following basis:

a) Where cables are laid in single tier formation, the total depth of trench shall not be less than 75 cm. for cables up to 1.1 KV and 1.20 m for cables above 33 KV.

b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in a (i) above shall be increased by 30 cm. for each additional tier to be formed.

EXCAVATION OF TRENCHES

a) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided complying with the requirements.
b) Where gradients and changes in depth are unavoidable, these shall be gradual.

c) Excavation shall be done by any suitable means-manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

d) Adequate precautions shall be taken not to damage any existing cables, pipes or other such installations in the proposed route during excavation. Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried without the approval of the Engineer-in-Charge.

e) Existing property exposed during trenching shall be temporarily supported or propped adequately as directed by the Engineer in charge. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein and the trench refilled.

f) If there is any danger of a trench collapsing and endangering adjacent structures, the sides should be well shored up with timbering and/or sheeting as the excavation proceeds. Where necessary, these may even be left in places when back filling the trench.

g) Excavation through lawns shall be done in consultation with the staff of the department/Owner concerned.

h) The bottom of the trench 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 8 cm. in depth.

**LAYING OF CABLE IN TRENCH**

a) At the time of issue of cable for laying, the cores shall be tested for continuity and insulation resistance.

b) The cable drum shall be properly mounted on jacks or on a cable wheel, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

c) The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be pulled of in one stretch. However, where this is not possible the remainder of the cable may be removed by ‘Flaking’ i.e. by making one long loop in the reverse direction.

d) i) After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.

ii) For short runs and sizes up to 50 Sq. mm of cables up to 1.1 KV grade, any other suitable method of direct handling and laying can be adopted with the prior approval of the Engineer-in-Charge.

e) When the cable has been properly straightened, the cores shall be tested for continuity and insulation resistance. In case of PVC cables, suitable moisture seal tape shall be used for this purpose.

f) i) Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid.
ii) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cm shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm. as stated above. The top most cable shall have a final sand covering not less than 17 cm. before the protective cover is laid.

g) At the time of original installation, approximately 3 m of surplus cable shall be left on each end the cable and on each side of underground joints (Straight through/Tee/Termination) and at entries and places as may be decided by the Engineer-in-Charge. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length loose cable may be left at suitable intervals as specified by the Engineer-in-Charge.

h) A final protection to cables shall be laid in accordance with Clause j to provide warning to future excavators of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc.

i) 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, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Engineer-in-Charge. 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 the end cables.

BACK FILLING

a) The trenches shall be back-filled with excavated earth free from stones 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 centre and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth however should not exceed 10 cm. so as not to be a hazard to vehicular traffic. The temporary re-instatement of roadways should be inspected at regular intervals, particularly during the wet weather, and any settlement should be made good. Further trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved in accordance with the relevant Specifications to the satisfaction of the Engineer-in-Charge.

b) Where road berms or lawns have been cut or kerb stones displaced, the same shall be repaired and made good except turfing/asphalting to the satisfaction of the Engineer-in-Charge and all surplus earth or rock removed to places as specified.

ROUTE MARKERS:

a) Route markers shall be provided along straight runs of the cables at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 100 m. Markers shall also be provided to identify change in the direction of the cable route and also for location of every underground joint.

b) Route markers shall be made out of 100 mm x 100 mm x 5 mm GI/Aluminium plate, welded or bolted on to 35 mm x 35 mm x 6 mm angle iron 60 cm. long. Such plate markers shall be mounted parallel to and 0.5 m or so away from the edge of the trench.

Alternatively cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) marker 60 cm x 60 cm 10 cm in size shall be laid flat and centred over the cable. The concrete markers unless otherwise instructed by the Engineer-in-Charge shall project over the surrounding surface so as to make the cable route easily identifiable.
c) The work ‘cable’ and other details such as voltage grading, size etc. as furnished by the Engineer-in-Charge shall be inscribed on the marker.

**LAYING IN PIPES/CLOSED DUCTS:**

In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the Civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embedded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. from the ground level when laid under roads, pavement etc.

Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of poly phase system.

The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

Manholes of adequate size as decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Engineer-in-Charge through another agency. Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.

All chases and passages necessary for laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge. Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

**3.1.9 LAYING ON CABLE TRAY**

Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.

The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, and structural steel members (comprising of channels, angles, flats, rods) for structural supports for cable trays etc.

**CABLE TRAY MOUNTING**
Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following:

a) Cable tray mounting arrangement type to be as marked on layout drawing.

b) Assembly of tray mounting structure shall be supplied, fabricated, erected & painted by the contractor.

c) Cable tray running along the wall should be supported at intervals not exceeding 1.5 m. In case of branching, there should be a support on all branches at a distance of 30 cm from the point of branching. Support should not be less than 40 mm x 40 mm x 5 mm MS angle-secured in an approved manner where runs are along the walls. In case of ceiling suspended cable tray horizontal supports made of 40 mm x 40 mm 5 mm MS angle iron shall be provided. The horizontal interval between two such supports shall be 1.0 meter. These supports shall be suspended from C.I. boxes or suitable approved suspension devices such as dash fastener of suitable sizes in the ceiling by means of 10 mm diameter GI threaded rods. All above mounting accessories form part of installation of cable trays.

**TESTING & COMMISSIONING**

**INSPECTION**

All cables shall be inspected upon receipt at site and checked by the Engineer-in-Charge for any damage during transit.

**TESTING**

i. All 650/1100 Volt grade cables before laying shall be tested with a 500 V megger or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/Amour and insulation resistance between conductors.

ii. All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

**COMPLETION PLAN AND COMPLETION CERTIFICATE**

a) After completion of the work the Contractor shall draw completion plans to a suitable scale and shall submit to the Engineer-in-Charge. The completion plans shall, inter-alia, give the following details

i) Layout of cable work

ii) Length, size, type and grade of cables.

iii) Method of laying i.e. direct in ground, in pipes etc.

iv) Location of each joint with jointing method followed.

v) Route marker and joint maker with respect to permanent land marks available at site.

vi) Wherever the previously laid cable is cut and additional joints are introduced etc., the cable records shall suitably be amended.

**TESTING OF CABLES**

The cables shall be tested before and after laying. The Megger value in normal dry weather shall be 50 Mega ohm for 1.1 KV grade cable. This value shall be 100 Mega ohm for 11 KV grade cable.
CABLE TAGS

Cable tags shall be made out of 2mm thick aluminium 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 glancing 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 aluminium strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws and washers, 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 C.I. plate marked with “DANGER 1.1 KV CABLE” with 0.6 meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

3.2 CABLE TRAY

All cables trays shall be made of M.S. sheet.

Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays. The bends, Tee joint, Cross joint for all sizes of cable tray shall be factory fabricated.

Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

3.2.1 PERFORATED CABLE TRAY

Standard dimensions of perforated cable trays shall be as follows:

1. Width : 100 mm to 1200 mm
2. Length : 2500 mm
3. Thickness : 1.6mm up to 300 mm width and 2mm 450 mm to 600 mm width and 3mm from 901mm to 1200 mm
4. Collar height : 50 mm up to 600 mm and 75 mm from 750 mm to 1200mm

3.3 SAFETY MATERIALS

3.3.1 DESCRIPTION OF WORK

A. Insulation Mats
B. First Aid charts and First Aid Box
C. Danger Plate
D. Fire Extinguishers
E. Fire Buckets
F. Tool Box
G. Caution Board
H. Key Board

3.3.2 APPLICABLE CODES & STANDARDS

A. IS : 15652 Insulation mats
B. IS : 2878 Portable C02 Fire Extinguisher
C. IS : 2546 : Fire Buckets

3.3.3 SUBMITTALS

A. Product Catalogues.

3.3.4 SPECIFICATION

3.3.4.1 INSULATION MATS

A. Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

3.3.4.2 FIRST AID CHART AND FIRST AID BOX

A. Charts (one in English, one in Hindi, one in Regional Language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate places. Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in sub-station.

3.3.4.3 DANGER PLATE

A. Danger plates shall be provided on HV and LV equipments. LV danger notice plate shall be 200 mm x 200 mm made of mild steel atleast 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

B. Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick.

3.3.4.4 FIRE EXTINGUISHERS

A. Portable CO2 conforming to IS: 2878-1976 dry chemical (conforming to IS 2171-1976) extinguishers shall be installed in the sub-station at suitable places (like HT/LT panel rooms) as specified.

B. Foam type fire extinguisher shall be installed in Transformer Room.

3.3.4.5 FIRE BUCKETS

A. Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

3.3.4.6 TOOL BOX

A. A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

3.3.4.7 CAUTION BOARD
A. Necessary number of caution boards such as "Man on Line" "Don't switch on" etc. shall be available in the sub-station.

B. The Caution Board shall be of size 300 mm x 200mm made of mild steel, 2mm thick, vitreous enamelled white on both sides and with inscriptions in original red colour on front side as required.

3.3.4.8 **KEY BOARD**

A. A key board of required size shall be provided at a proper place containing castel keys, and all other keys of sub-station and allied areas.

B. The Key board shall be made of 12mm thick first class teak wood shall be of size 400 mm x 300m and with adequate depth to hold the keys. It shall be provided with a lockable type hinged glass door made of 12 mm thick first class teakwood frame with 3 mm thick sheet glass fixed with piano hinges. The key board shall enough number of hooks for hanging the castle keys and all other keys of the sub-station and allied areas. It shall be painted with one coat of wood primer and two coats of white enamel paint.

3.3.5 **SUBMITTALS**

**SHOP DRAWING AND TECHNICAL DATA**

The Tenderer shall furnish relevant technical data on H.T. Metering Panel and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

c) All drawings and data shall be in English.

3.3.6 **TYPE AND CONSTRUCTION**

The metal clad panel shall be made out of 2.0 mm thick CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer’s standard shade.

a. C.T. & P.T. Compartment

b. Energy Meter Compartment

c. Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. The H.T. Metering Panel shall be suitable for cable termination from bottom only. The Panel shall be supplied with all equipment mentioned in BOQ and as per regulation of Local Electricity Supply Authority.
3.4 SUB DISTRIBUTION PANEL

3.4.1 GENERAL

Sub Distribution Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

3.4.2 STANDARDS

The equipment shall be designed to conform to the requirements of:

IS 8623 – Factory Built Assemblies of switchgear and control gear.
IS 4237 – General requirements for switchgear and control gear for voltages not exceeding 1000 volts.
IS 2147 – Degrees of protection provided by enclosures for low voltage switchgear and control gear.
IS 375 – Marking and arrangement of bus bars.

Individual equipment housed in the sub distribution boards shall conform to the following IS specifications:

b) Miniature Circuit Breaker - IEC - 60898
c) Contractors - IEC – 947-4-1, IS 13947-4-1
d) Current Transformers - IS: 2705
e) Indicating Instruments (Analogue) - IS: 1248,
f) Indicating Instruments (Digital) - IS: 13875
g) Integrating Instruments (Analogue) - IS: 722, IS: 13779-1999
h) Integrating Instruments (Digital) - IS: 13779- 1999, IS: 14697
i) HRC fuse links - IS: 13703 / IEC 269

3.4.3 SUBMITTALS

Shop Drawings And Technical Data-

The tenderer shall furnish relevant technical data of switchgears and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on switchgears and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams and control wiring.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) All drawings and data shall be in English.

3.4.4 CONSTRUCTIONS

Sub Distribution boards shall be metal enclosed, indoor, floor mounted free standing and/or wall mounted type made up of the required vertical section, which when coupled together shall form continuous dead front. Sub distribution boards shall be dust and damp protected, the degree of protection being no less than IP: 54 to IS:2147. Sub distribution boards shall be fabricated with a
framed structure with rolled/folded sheet steel channel section of Sheet steel shroud and partitions shall be of minimum 2mm thickness, doors and covers shall also be of 2mm thickness. All panel doors shall be pad lockable type. All sheet steel work forming the exterior of sub distribution boards shall be smoothly finished, leveled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust proof including neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearance to be maintained after taking into account connecting bolts, clamps etc.

i) Between Phases - 32mm  
ii) Between Phases and neutral - 26mm  
iii) Between Phases and earth - 26mm  
iv) Between Neutral & earth - 26mm

All insulating, materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. SMC (Sheet Moulded Compound) supports & shrouds shall be used.

Functional units such as moulded case circuit breakers shall be arranged in multi-tier formation. The design of the sub distribution boards shall be such that each MCCB unit shall be fully compartmentalized.

Insulated barriers shall be provided with vertical section and between adjacent section to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fastness to prevent unauthorized access. Sub distribution boards shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables.

For each cable alley, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3 mm thick.

A base frame made out of 75mm x 40mm x 5.0mm M.S. Channel to be provided.

### 3.4.5 METAL TREATMENT AND FINISH

All metal work used in the construction of the sub distribution boards should have undergone a rigorous metal treatment process as follows:

- a) Effective cleaning by hot non alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution

- b) Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

- c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

- d) Passivating in de-oxalite solution to retain and augment the effects of phosphating.

- e) Drying with compressed air in a dust free atmosphere.

- f) A finishing coat of powder coating of Siemens grey colour and thickness of powder coating shall not be less than 50 micron.
3.4.6 BUS BARS

The bus bars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade E-91E.

The bus bars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 35KA RMS symmetrical for one second or as specified in BOQ/Drawing and a peak short circuit with stand capacity of 105 KA.

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creepage distance shall be provided on the bus bar system to minimize the possibility of fault. The main phase bus bars shall have continues current rating throughout the length of the panel. The cross section of neutral bus bars shall be same as that of the phase bus bar for bus bars of capacity up to 250 Amp; for higher capacities, the neutral bus bar shall not be less than half (50%) the cross section of that of the phase bus bars. Connections from the main bus bars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars shall be colour coded with PVC heat shrinkable sleeves.

The sub distribution boards shall be designed that the cables are not directly terminated on the terminals of MCCB etc. but are terminated on cable termination links. Capacity of aluminium bus bars shall be considered as 0.8 Amp per sq. mm of cross section area of the bus bars.

3.4.7 MOULDED CASE CIRCUIT BREAKERS

GENERAL

Moulded Case Circuit Breakers shall be incorporated in sub distribution boards wherever specified. MCCB’s shall conform to IS 13947-2 and / or IEC 947-2 in all respects. MCCB’s shall be suitable either for single phase AC 230 volts or three phase 415 volts. All MCCB shall be provided with rotary operating mechanism.

All MCCBs shall be suitable for 3 Phase 415 Volts AC 50 HZ supply.

All MCCBs shall have rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at defined operational voltage.

All MCCBs shall clearly indicate the suitability for isolation in the name plate identified by the symbol .

All MCCBs shall offer class –II front face i.e. main current path of the circuit breaker should be isolated from auxiliary section

All MCCBs shall have cross bolted termination.

All MCCBs above 250A shall have the following features

- Single frame size with common accessories to reduce inventory
- Microprocessor trip unit
- Adjustable overload settings – 0.5-1 In
- Adjustable Short circuit – 2-10 Ir
- Adjustable neutral for 4P MCCBs – 0-0.5Ir-1Ir
- Thermal memory
- Test connector to check the healthiness of trip unit
- 4000 electrical operations
- ON/OFF/Trip/Push to trip indication contacts

All MCCBs up to 250A shall have following features

- Single frame size with common accessories to reduce inventory
- Thermal magnetic trip unit
- Adjustable overload settings – 0.7-1 In
- Fixed short circuit settings
- Fully rated neutral for 4P MCCB
- 10000 electrical operations
- ON/OFF/Trip/Push to trip indication contacts
Individual fault trip LED indications shall be available on all types of trip units for easy & faster identifying the cause of fault.

\( I^2t \) ON / \( I^2t \) OFF options shall be available for short-circuit & earth fault protections to enhance discrimination with downstream devices.

The trip unit shall have integral test facility to verify the healthiness and to avoid external calibration.

The release shall be self diagnostic type with clear LED indication in case of mal functioning.

It shall be possible to change the protection settings on line and the circuit breaker need not be switched of while adjusting the setting.

Circuit breakers shall conform to Electromagnetic compatibility tests (EMC) as specified in IEC 60947-2, Appendix F.

Manufacturer shall submit the test certificates for the same.

The control unit shall have thermal memory throughout the range to store temperature rise data in case of repetitive overload or earth fault for protecting the cables and loads.

RUPTURING CAPACITY

The Moulded Case Circuit Breaker shall have a minimum fault breaking capacity (Ics) of not less than 35 KA RMS at 415 volts or as specified in BOQ./ Drawing.

TESTING

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished. Pre-commissioning tests on the sub distribution boards incorporating the MCCB shall be done as per standard.

3.4.8 MEASURING INSTRUMENTS, FOR METERING:-

GENERAL

Direct reading electrical instruments shall be in conform to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltometers intended to be used on three phase supply.

The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

DIGITAL AMMETERS
Digital Ammeters shall be confirm to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

DIGITAL VOLTMETERS

Digital Voltmeters shall be confirm to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring</td>
<td>Class 1.0</td>
</tr>
<tr>
<td>Protection</td>
<td>Class 5 P10</td>
</tr>
</tbody>
</table>

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

3.4.9 CONTROL SWITCHES

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

3.4.10 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.
Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

### 3.4.11 CONTROL WIRING

All control wirings shall be carried out with 1100V grade single core FRLS cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

### 3.4.12 TERMINAL BLOCK

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

### 3.4.13 LABELS

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

### 3.4.14 TESTING AT MANUFACTURING WORK

All routine tests specified is IS: 8623-1977 shall be carried out and test certificates submitted to the Engineer – in – Charge.

### 3.4.15 TESTING AND COMMISSIONING

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check
- c) Insulation test: When measured with 500 V meggar, the insulation resistance shall not be less than 100 mega ohms.
- d) Trip tests & protection gear test.

### 3.5 DISTRIBUTION BOARDS

#### 3.5.1 GENERAL

- a) Distribution Board shall be double door type with extended loose wire box & M.S. Junction Box at the top and suitable for flush installation. All distribution boards shall be of three phase (415 Volts) or single phase (240 Volts) type with incoming isolator or MCB and/or ELCB as in Bill of Quantities. Distribution boards shall contain plug in type miniature circuit breaker mounted on bus bars. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS 8828-1978 & IS 8828 - 1996. Bus bars shall be of electrolytic copper. Neutral bus bars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Separate neutral & earth bus bar link to be provided for each phase. Phase barrier shall be fitted and all live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have an etched zinc base stove painted followed by synthetic stoved enamel, colour light gray. A circuit identification card in clear plastic cover shall be provided for each distribution board. IK (Mechanical Stress) rating of distribution board enclosure shall not be less than IK –07/ 08 / 09.
b) Distribution Board with single phase outgoings requirement shall be Horizontal type. Distribution Board with three phase outgoings requirement shall be Vertical/ Horizontal type. Distribution Board installed in indoor dry locations shall conform to IP-42. Distribution Board installed in outdoor & wet locations shall conform to IP-65.

c) Miniature Circuit Breakers for lighting circuits shall be of "B" series where as the circuits feeding discharge lamps (HPMV or HPSV) halogen lamps, all power outlet points, equipment/ machinery shall be of "C/D" series (Motor circuit) types. All miniature circuit breakers shall be of not less than 10KA rated rupturing capacity. All miniature circuit breaker terminal shall have safety shutter.

d) Distribution board shall be provided with isolator or MCB and/or earth leakage circuit breaker as mentioned in drawings and BOQ. Earth leakage circuit breaker shall be current operated type and of 30mA sensitivity unless otherwise stated. ELCB shall be mounted within distribution board box for single phase distribution board while in three phase distribution board ELCB shall be either mounted within distribution board box or in a separate MS box below distribution board. Width and depth of ELCB box shall be same as that of distribution board box and of same finish. Height of ELCB box shall be sufficient to accommodate ELCB & termination of incoming & outgoing wires. Distribution board box, isolator, MCB'S used shall be of one/same manufacturer. Standard size manufactured by approved manufacturer shall be used. In case size specified in BOQ is not standard size of manufacturer, in that case next standard size distribution board box shall be used with incoming & outgoing MCB as specified in BOQ. Additional cutout/space for outgoing MCB shall be plugged with blank plates. No extra cost shall be paid for using bigger/higher size distribution board box and blank plates.

3.6 **CONDUIT AND WIRING SYSTEM**

3.6.1 **PVC CONDUIT**

Conduits shall be heavy gauge rigid PVC of minimum thickness of 2mm. Conduits shall be ISI marked confirming to IS: 9537 (Part-3)-1983. All conduit and conduit accessories shall be of PVC. Conduit shall be jointed together by a vinyile type cement/solvents. Minimum size of conduit shall be 25mm unless otherwise mentioned in BOQ or drawing. Conduit shall be fixed on ceiling or wall. All conduits shall be concealed in wall/ceiling etc. or fixed on surface of wall with clamps at regular interval as called for elsewhere. For termination of PVC conduits into switch outlet box, PVC female adopters shall be used. Wherever conduit run exceeds 10 metre, circular junction boxes shall be provided to facilitate pulling & inspection of wires. Inspection boxes shall be suitably located in co-ordination with the Engineer-in-charge. Conduits shall be bend using suitable size springs. Long radius bends shall be provided. Heating shall not be used to bend the conduits. Size of conduit shall depend upon number and size of wires to be drawn.

3.6.2 **M.S. CONDUIT**

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with stove enameled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS code. No steel conduit less than 20mm in diameter shall be used unless otherwise stated.

**CONDUIT JOINTS**

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13mm to 19mm long sufficient to accommodate pipes to full threaded portion of couplers.
or accessories. Cut ends of conduit pipe shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

Wherever conduit passes a building expansion joint, galvanized flexible metallic conduit shall be provided for connecting rigid M.S. Conduit in either slab.

**PROTECTION AGAINST CONDENSATION**

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

**PROTECTION OF CONDUIT AGAINST RUST**

The outer surface of conduit including all bends, unions, tees, junction boxes etc forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

**PAINTING OF CONDUIT AND ACCESSORIES**

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc. shall be painted with two coats of approved enameled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

**FIXING OF CONDUITS**

**SURFACE CONDUIT**

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other 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 30cm from the centre of such fittings. The saddles should not be less than 24 gauge for conduits up to 25mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19mm & 25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Where as it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used. All fixing arrangement like saddles, special purpose clamps, nuts, bolts etc. shall deemed to be included in quoted rates of conduit.

For 25mm diameter conduit width of clip shall be 19mm and of 20 SWG. For conduit of 32mm and above, width of clip shall be 25mm and of 18 SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer-In-Charge at site.

**RECESS / CONCEALED CONDUIT**

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. 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. Entire work of chasing the wall, fixing the conduit in chases, and during the conduit in mortar before plastering shall form part of point wiring work. (For chase cutting-chase cutting machine shall be used and no manual cutting shall be allowed) The conduit pipe shall be fixed by means of stapples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be
avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius which shall permit easy drawing in of conductors. All threaded joint of conduit pipe shall treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 metres, then circular junction box shall be provided to facilitate pulling of wires. The chicken wire mesh shall be provided by civil agency.

**OUTLET BOXES:**

Switch/outlet boxes shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Upto 20 x 30cm size M.S. Box shall have wall thickness of 16 SWG and MS boxes above 20x30cm size shall be of 14 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm. all fitting shall be fitted in flush pattern. Switch/outlet boxes shall be suitable to house modular type light and power accessories. Earthing stud to be provided for connection of earthing wire in side of box at near any corner. Nakka shall be 3 mm thick.

**FAN BOX:**

Fan Box shall be made out of 14 gauge M.S. sheet in hexagonal shape. The dia of box shall be 150 mm and depth of box shall be 80 mm. A M.S. cover plate size 160 mm x 160mm x 16 gauge to be provided in the back of fan box. 12 mm dia M.S. Rod to be provided for fan hanging arrangement in the box. A 28 mm dia knockout To be made in all six hexagonal vertical part for conduit entry in the box. The box shall be painted with 2 coat of primer. A 180 mm dia, 2 mm thick hylem sheet Cover to be provided. (The sample to be approved before procurement / execution by owner / consultant.)

**JUNCTION TEE / DEEP TEE :-**

The tee shall be made out of C.I. material. The dia of tee shall be 60 mm and the Depth of tee shall be 70 mm. The thickness of deep tee wall shall be 1.3mm to 1.5mm. (The sample to be approved before procurement execution by owner / consultant.)

**ERECTION AND EARTHING OF CONDUITS:-**

The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirement by means of special approved type of earthing clamp effectively fastened to conduit pipe in a workmen like manner for a perfect continuity between the earth and conduit. Gas, water pipe shall not be used as earth medium.

3.6.3 LIGHT & POWER ACCESSORIES:-

**GENERAL**

All light & power accessories shall be of modular range of plate switch type and shall be of one manufacturer (brand) and type.

**LIGHT SWITCHES**

All switches for control of light shall be of 6/10 Amp unless otherwise stated. All switches shall be modular range of plate switch type. The switches shall be rocker mechanism type with silver contract. All switches shall be of white finish or as sample approved by owner/consultant.

**6/16 AMP SWITCH SOCKET OUTLET.**
Switch socket outlet on lighting circuit shall be of 3 pin 6Amp outlet shall have safety shutters. The switch shall be of rocker mechanism type with silver contact. Socket outlet shall be shutter type and of modular range of plate type and having white finish. Switch and socket outlet shall be mounted on a suitable size GI box with suitable size modular cover plate.

Switch socket outlet on power circuit shall be of 6 pin 16/6 Amp outlet (Universal Socket) shall have safety shutters. The switch shall be of rocker mechanism type with silver contacts. Socket outlet shall be shutter type and of modular range of plate type and having white finish. Switch and socket outlet shall be mounted on a suitable size GI box with suitable size modular cover plate.

**TELEPHONE OUTLET**

Each Telephone outlet location shall be provided with 1 No. telephone Jack type outlet (RJ11). The telephone outlet shall be of modular range of plate switch type and shall be mounted on a suitable size GI Box with modular range cover plate.

**WIRING**

All FRLS insulated copper conductor multi-stranded wires shall conform to relevant IS codes. Cable conductor size and material shall be as specified in BOQ.

All internal wiring shall be carried out with FRLS insulated wires of 1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switch board may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switch boards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red or yellow or blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FRLS insulated wire for RYB phase wire respectively and black colour FRLS insulated wire for the neutral wires. FRLS insulated green colour wire shall be used as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications.

**JOINTS**

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

**SUB MAINS**

Sub-main wiring shall be carried out with FRLS Insulated Copper multi-stranded wires/cables in suitable M.S Conduit unless otherwise specified in BOQ / drawing.

Sub-main cable where called for shall be of the rated capacity and approved make. Every sub-main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the sub-main cables. Cost of junction box/drawn box is deemed to be included in the rates of sub-main wiring. An independent FRLS insulated copper earth wire of proper rating shall be provided for every sub-main. Single phase sub-main shall have single earth wire whereas three phase sub-main shall be provided with two earth wire.

Where sub-mains cables are connected to the switchgear, sufficient extra lengths of sub-main and mains cable shall be provided to facilitate easy connections and maintenance. For termination of
cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed.

**LOAD BALANCING**

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

**COLOUR CODE FOR CIRCUIT & SUB-MAIN WIRING**

Colour code for circuit & sub-main wiring installation shall be Red, Yellow, Blue for three phases. Black for neutral and green for earth in case of insulated earth wire.

### 3.6.4 CLASSIFICATION OF POINTS:

**General**

Classification and measurement of Point wiring shall be as follows:

Conduiting & wiring from switch to first point including circuit wiring along with conduits, shall be classified as “One point (First point) controlled by one number 6Amp one way/two way switch”.

Conduiting & wiring from first point to next point to be controlled by same switch in same circuit shall be classified as “Looping Points”.

**CONDUCTOR SIZE**

Wiring shall be carried out with following sizes of FRLS insulated multi-stranded single core copper conductor wire/cable.

<table>
<thead>
<tr>
<th>Point Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light point</td>
<td>1.5 Sq.mm</td>
</tr>
<tr>
<td>Ceiling/Cabin/Exhaust Fan Point</td>
<td>1.5 Sq.mm</td>
</tr>
<tr>
<td>Plug Point (5 A SS outlet)</td>
<td>1.5 Sq.mm</td>
</tr>
<tr>
<td>Circuit Wiring</td>
<td>2.5 Sq.mm</td>
</tr>
<tr>
<td>MCB Control Light Point</td>
<td>2.5 Sq.mm</td>
</tr>
<tr>
<td>General Power Point (15A S.S. outlet)-First Point</td>
<td>2.5 Sq.mm</td>
</tr>
<tr>
<td>General Power Point (15A S.S. outlet)-Second Point</td>
<td>2.5 Sq.mm</td>
</tr>
<tr>
<td>Power Point for Geyser / A.C. Unit</td>
<td>4.0 Sq.mm</td>
</tr>
</tbody>
</table>

### 3.6.5 TELEPHONE WIRE/CABLES:

Separate conduits shall be provided for internal telephone wiring of telephone system commencing from tag block. Each telephone outlet shall be wired with 2 pair telephone cable from the tag block. All telephone wires shall be of 0.5mm dia annealed tinned high conductivity copper conductor PVC insulated & PVC sheathed grey conforming to ITD specification SWS 113 B&C. Multipair PVC insulated cables laid in conduit shall be provided for connecting various tag blocks. Telephone cables used for external connections shall be armoured. These cable shall be laid directly in ground or in pipe etc. as call for elsewhere.

Following number of 2 pair wires/cables shall be drawn in various sizes of conduits as listed below.

- 25mm conduit: Up to 6 Cables

All telephone cables used in the building shall be PVC insulated PVC sheathed.

### 3.6.6 TELEPHONE DISTRIBUTION BOARDS (TAG BLOCK):

Tag block shall be mounted in M.S. box fabricated from 1.63 mm thick sheet steel. Box shall undergo a rigorous metal treatment process i.e. degreasing, pickling, phospating, pasivating in de oxalate.
solution, dry with compressed air in dust free atmospheric facility and disconnection module shall be in multiple of 10 pairs. Disconnection unit shall be mounted on back mounting frame.

Maximum number of PVC insulated 650/1100 V grade aluminium / copper conductor cable conforming to IS: 694 – 1990, that can be drawn into rigid PVC/MS conduit.

<table>
<thead>
<tr>
<th>Nominal Cross-sectional Area of conductor in Sq. mm</th>
<th>20mm</th>
<th>25mm</th>
<th>32mm</th>
<th>38mm</th>
<th>51mm</th>
<th>64mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.50</td>
<td>5</td>
<td>4</td>
<td>10</td>
<td>8</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>2.50</td>
<td>5</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
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<td>5</td>
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<td>6</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>70</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
</tbody>
</table>

**NOTE:**

The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables. The columns headed ‘S’ apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed ‘B’ apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees. Conduit sizes are the nominal external diameters.

### 3.6.7 Supply and Installation of Light Fixture:

**Supports and Fixings**

Where fluorescent luminaries 1200 mm or more in length are supported directly by the conduit system they shall be fixed with light point junction boxes of which shall form an integral part of the conduit system.

Where the weight of the luminaire is supported by a conduit box or cable trunking the fixing of the conduit box or trunking shall be adequate for the purpose and approved by Architect/Consultant.

Luminaires fitted with tungsten filament, lamps and having metal back plates shall not be fixed directly to conduit box in which a thermoplastic material is the principal load-bearing member.

Support of luminaires from cable trunking shall be by means of appropriate clamps or brackets.

Luminaires mounted on or recessed into suspended ceilings shall not be support on the false ceiling unless specifically shown and approved.

For wall mounted luminaires, the mounting height specified on drawings shall be above finished floor level measured to the centre of the conduit box, unless otherwise indicated.

**Wiring Connections**

Where luminaires, other than those are fixed direct to circular boxes or supported by pendants or chains, the final circuit wiring shall terminate at a terminal block in the conduit box.
Where luminaires having fluorescent tubes are fixed direct to circular conduit boxes, the final circuit wiring may be terminated within the luminaire unless otherwise indicated. The wiring shall enter each luminaire at the conduit entry nearest to the terminal block and where the loop – in wiring system is used leave by same entry wiring shall not pass through a luminaire.

Where luminaires are mounted on or recessed into a suspended ceiling connection shall be by flexible cord from a plug in ceiling rose shall be located not more than 500 mm from the access panel in the ceiling and shall be firmly supported, unless otherwise approved by the consultant.

Cables and flexible cords for final connections to luminaires shall be suitable for the operating temperature of the luminaire. Flexible cords for chain suspensions, if any shall have a white sheath unless otherwise indicated.

The size of final connection cables or flexible cords shall be as indicated. Cables and cords passing close to ballast within a luminaire shall be suitable for the operating temperature of the ballast. Heat resistant sleeves shall be provided.

A protective conductor shall connect the earthing terminal or earthing contact of each luminaire to an earthing terminal incorporated in the adjacent conduit box. Where the final connection is by flexible cord the protective conductor shall form part of the cord.

Where luminaires are recessed in the false ceiling, luminaires shall be suspended with MS conduit with ball & socket arrangement, check nut etc. Suspension arrangement shall be fixed to steel/RCC structure with suitable purpose made clamps etc. (Cost of suspension arrangement is deemed to be included in the rate of installation/erection of luminaires). Contractor shall submit the shop drawing for proposed suspension arrangement of various types of light fixtures in various type of ceiling and shall obtain necessary approval from the Engineer-in-Charge.

The light fixtures and fans shall be assembled and installed in position complete and ready for service in accordance with the detailed drawings, manufacturer’s instructions and to the satisfaction of the Engineer-in-Charge. Fixtures shall be suspended true to alignment plumb level and capable of resisting all lateral and vertical forces and shall be fixed as required. All ceiling fans shall be provided with suspension arrangement in the concrete slab/roof members. It shall be the duty of the contractor to make these provisions at the appropriate stage & locations shown on the drawings. Fan box with MS hook shall be as per CPWD specifications. Suspended type fluorescent light fixture shall be fixed to circular junction box with a metallic ball and socket arrangement. Light fixture in general shall be directly fixed to ceiling slab with rawl plugs. All switch and outlet boxes shall be bonded to earth through connector blocks. MS pipe shall be fixed with suitable fixing accessories and metal continuity shall be maintained.

3.6.8 CONDUITING AND WIRING FOR SAMTV SYSTEM:

CONDUITING

Conduiting for SMATV system shall be carried out in M.S. Conduit. Conduiting shall be carried out as specified in point wiring head.

OUTLETS

All SMATV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.

JUNCTION BOX

Suitable size of metallic junction box shall be provided for termination of conduit for SAMTV system. Box shall be made of 1.6mm thick MS sheet and shall be treated before painting. Front of the junction box shall be provided with 3mm thick phenolic laminated sheet cover.

COAXIAL CABLES
The coaxial cable shall be of wideband type (RG-11 for Riser & RG-6 for distribution)

**TAP OFF**

These shall be of ultra wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance.

The Tap offs shall be in one way, two way and four way configurations.

**SPLITTERS**

These shall be of ultra wide band width and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance.

The splitters shall be in 2 way, 3 way & 4 way configurations

### 3.7 LIGHTNING PROTECTION

**GENERAL**

1. The advance lightning protection system shall be of the enhancing type designed to attract lightning from a predetermined volume and to safely convey the lightning current to earth through a known and preferred route.

2. The lightning protection system shall include components as follows: air termination(s) mechanical support(s), down conductor(s), performance recording equipment, and low impedance grounding system.

3. The Advanced Lightning protection system shall be mounted adequately rated for wind shear loading. Guying kits shall be provided as appropriate to local environmental conditions, or based on mast arrangement selected.

4. The Advanced Lightning protection shall be designed by a company engaged in the manufacture and development of Advanced Lightning system components, of types, sizes and ratings as shown, who can show evidence or support that their products have been in satisfactory service for not less than 10 years.

5. The lightning protection components (Air termination(s) and down conductor(s)) shall be compliant to UL-96.

**AIR TERMINATION**

1. The air termination shall be Controlled Leader Triggering / Controlled Streamer Emission (CSE) terminal

2. The air termination shall be working on the principle of Collection Volume Method Placement and Electric Field Intensification which responds dynamically to the appearance of a lightning down leader by creating free electrons needed to initiate an upward streamer and sudden increase in the electric field above the air terminal which provides the additional energy to initiate and convert s strong propagating upward leader.

3. The air terminal should have variable impedance unit for discharging the static charges into the ground during the buildup stage in the atmosphere.

4. The air termination shall be non-radioactive
5. Arcing is not to be continuous and shall only occur during the progress of the lightning leader. Arcing shall not occur solely due to electrostatic field when a thunderstorm is overhead except when there is leader activity in the region.

6. The external shape of the terminal shall be of Stainless Steel Semi Spherical type in order to significantly reduce the buildup of sharp point corona discharge under static field thunderstorm conditions.

7. The air termination shall be passive terminal not requiring internal or external power source for its operation. It shall have no moving parts and the materials of the air termination shall be non-corroding in normal atmosphere.

8. The materials of the air termination shall be non-corroding in normal atmosphere. The centre earthed finial shall be at least 300mm² in cross section and be made of electric grade non ferrous material. The outer metallic surfaces of the terminal shall be manufactured of anodised aluminium.

9. The air termination shall be insulated from the protected structure under all conditions.

10. The size of the collection volume and attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.

11. The termination shall be mounted a minimum of 10 metres from the ground.

12. The air termination(s) shall be compliant to UL-96: Lightning Protection Components (Standard for Safety).

13. The air termination shall be installed strictly to the manufacturer's instructions. It shall not be installed in corrosive environments or atmospheres without prior written approval from the manufacturer.

14. The protective zone provided by the air termination shall be such that it becomes the preferred strike point for all discharges exceeding a peak amplitude return strike current of X kA according to the statistical level Y per IEC61024. The design shall take account of upward leader competing projections on the structure.

<table>
<thead>
<tr>
<th>Strike Current (X)</th>
<th>Levels of Protection (Y)</th>
<th>Exceedance Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9 Ka</td>
<td>Protection Level I – Very High</td>
<td>99%</td>
</tr>
<tr>
<td>5.4 kA</td>
<td>Protection Level II - High</td>
<td>97%</td>
</tr>
<tr>
<td>10.1 kA</td>
<td>Protection Level III – Medium</td>
<td>91%</td>
</tr>
<tr>
<td>15.7 kA</td>
<td>Protection Level IV – Standard</td>
<td>84%</td>
</tr>
</tbody>
</table>

**AIR TERMINATION SUPPORT**

The air terminal support shall consist of a minimum of 2m of insulating re-enforced fiberglass cylindrical mast. The conductor shall pass through the centre of the mast, with the high voltage termination contained to the upper 1m of the mast.

The support shall be securely bolted to other mast materials with guy wires used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

**DOWNCONDUCTOR**

1. The down conductor shall consist of a plastic filler, copper conductor, inner insulation, outer copper conductor, conductive sheath, all concentrically arranged.
2. The characteristic of the Down Conductor should be as follows:
   i. Characteristics impedance of less than 12 Ω.
   ii. Inductance of 37 nH/m.
   iii. Capacitance of 0.75 nF/m.
   iv. Upper Termination Voltage Withstand of 250 kV.
   v. Resistance $R_{DC}$ of 0.5 mΩ/m and $R_{IMPULSE}$ of 6 mΩ/m
   vi. Cross Sectional Area of 55 sq. mm
   vii. Maximum diameter of 36 mm.
   viii. Weight of 1.2 kg/m.

3. The Down Conductor should discharge the lightning current to the ground with minimum danger of side flashing.

4. The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to bends of less than 0.5 metres radius.

5. The down conductor after routing, must be kept in constant physical contact with the structure via conductive clamps. The top 10% of the installed length from the terminal must be anchored at least every 1 metre. The lower must be anchored at least every 2 metres.

Performance recording equipment

Each protection system shall be supplied with a lightning event counter. The lightning event counter shall have a register that activates one count for every discharge where the peak current exceeds 1500A. The test wave shape shall be the 8/20us standard as defined by ANSI C62.41

The lightning event counter shall be robust, easy to install and housed in an IP67 rated enclosure. The counter shall operate from the energy of the lightning discharge and not rely on external or battery power to operate.

The lightning event counter shall be installed to the manufacturer’s instructions in a readily accessible manner so that readings can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range $-10^\circ$C to $+50^\circ$C.

Lightning Protection Maintenance Free Earth:

The grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the Advanced lightning protection system.

The earth should be done with minimum 4 nos of Copper Bonded Ground Rods of 250 Microns with 5 ft length and 5/8” diameter in single line or square depending on site conditions.

The earth rods be grounded and joined with minimum 25 meters of 99.9% pure 25 mm x 3 mm Copper Strip.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building and to arriving services is recommended. The resistance should be measured and the 10 ohms maximum figure achieved before such bonding is done.

Electrically conductive, non soluble Earth Enhancing Material may be used to help achieve low ground resistance provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

3.8 **FIRE ALARM SYSTEM**

DESCRIPTION:
The work shall consist of furnishing, installation, testing & commissioning of a complete high quality advanced technology early detection Intelligent Analogue Soft Addressable fire alarm system as shown on the drawings and specified herein.

REFERENCES FOR INSTALLATION:

- German Standards VDE (Verband Deutcher Electrotechniker)
  DIN VDE14675 and VDE 0833 Fire Alarm Systems

- NFPA- National Fire Protection Association
  NFPA 72

- British Standard Institute / European Standards
  All Applicable codes and standards including BS EN 54

SUBMITTALS:

A. Product data for fire alarm system components including dimensioned plans, sections, and elevations showing minimum clearances, installed features and devices, and list of materials and data.

B. Shop drawings.

C. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project.

D. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with any one of the referenced standards, completely with specifications and Vds approval/UL.

TRANSPORTATION, HANDLING AND STORAGE:

A. All the components of fire alarm system shall be provided in manufacturer’s original new and unopened packing bearing manufacturer’s name and label.

B. Store materials, not in actual use, in covered and well ventilated area and protect them from dirt, dust, moisture, direct sunlight and extreme temperatures.

C. For further requirements follow manufacturer’s written instructions regarding storage and handling.

WARRANTY

A. Submit written guarantee signed by the contractor, manufacturer and installer of fire alarm system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

QUALITY ASSURANCE:

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of fire alarm systems and components, whose products have been in satisfactory use in similar services for not less than 3 years period, and be subject to approval of engineer.
B. Installer Qualifications: An experienced specialist sub-contractor who is authorized by the system manufacturer, and subject to approval of the engineer.

C. All the components and installations shall comply with the requirements of DIN VDE 14675 & VDE 0833/NFPA for design & installation.

D. Provide system and components specified in this section that are listed and approved by Vds & conform to equivalent DIN/EN/UL standards.

E. Single source responsibility: All components and accessories shall be product of signle manufacturer.

SYSTEM DESCRIPTION:

A. The fire detection and alarm system shall comprise of Automatic Soft Addressable Modular design main fire alarm control panels, Dual optical smoke & heat MULTI Sensors, Blue LED Optical Smoke & Heat MULTI Sensors, Optical Smoke / Heat/ CO Gas MULTI sensors, Loop powered Dual Optical Smoke/Heat sensor with integral Sounder / Flasher / Speech units, manual call points, electronic wall mounted Alarm sounder/flasher/speech combined devices, Transponder interface units, each with its own short circuit built-in isolators. All loop cabling and any other components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of DIN EN 54. The system shall be fully programmed to accommodate fire alarm zones. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to existing buildings/network on site.

B. The fire alarm and detection system shall provide the following facilities as a minimum:

The system shall be intelligent in operation with advanced decentralised intelligence technology. Each detector shall have its own processor with algorithms built in the device to take a fire or fault decision. System with centralised intelligence by providing signal levels to the control panel are not acceptable.

The system will be capable of providing fire, fault disablement and supervisory monitoring facilities as required by DIN EN 54 Pt 2. All devices on a loop shall have built in SHORT CIRCUIT LINE ISOLATORS for wiring fault isolation to protect the system. “Group Circuit Monitors” which isolate/protect sections of a loop circuit, i.e. a group of field devices are not acceptable.

All system components and devices shall be connected to two-wire loop circuits (as shown in the typical schematics) with each component having its own individual built-in isolator, should have sensors with integrated sounder in a same unit and no extra cabling should require to power up the sounder. Removal or disconnection of any component from the loop shall not affect the functioning and performance of other components and the system. Please note that the group isolators, which are used to isolate a section of a loop in case of fault, are not acceptable.

System shall be of automatically addressable type i.e. all the devices on the loops of the FACP shall be allocated addresses automatically from the PC / panel at the time of system power. The loop devices shall also be able to commission by using PC interface without the need of FACP.
And also given an address during commissioning, the value of which shall be stored in non-volatile memory, within the electronics module of the outstation. This value shall be read during loop allocation and provided it is valid shall be used to setup the outstations primary address.

Automatic Addressing shall cover the benefits of Soft Addressing and also overcome the limitations of Hard Addressing. This means that if the devices are inserted or removed all the existing devices shall keep the same address and programmed activations and use labels remain unchanged. The panel with PC shall allocate the address to ensure that it is impossible for two devices to have the same address. Fire Detection and Alarm Systems, which rely only on Coding, Programmer or hard addressing techniques are not acceptable.

Facilities shall be provided to constantly monitor and check the following circuits and fault conditions:

- The power supply to the loop /s;
- For open-circuit, short-circuit, earth fault and any other fault condition in the loop wiring;
- For communication failure and errors in all cards and loops
- For faults in keyboard and printer circuits
- All devices, etc. shall be installed on the same loop.

All devices shall be assigned a maximum of 25 character or 2 lines of max. 30 characters each with a ¼ VGA Display. In case of fire, fault or warning, the label of device sensing threshold shall appear on visual display unit of the panel.

Any event i.e. Fire, fault or warning shall be recorded with time, date and place of occurrence in the memory of FACP. These events can either be displayed on normal or ¼ VGA Display of the FACP or printed, as required. Provision shall be done at the fire alarm control panels to silence the loop powered alarm sounders but the visual indication shall remain until the system is reset. The detectors shall have auto learn sensitivity adjustments. The main fire alarm control panels shall be located as shown on the schematics and the floor drawings.

GENERAL

A. All major component of fire alarm system shall be product of a single manufacturer and shall conform to the requirement of EN54, Vds,UL approved and be designed acc. to DIN VDE14675 and VDE 0833/NFPA Fire Alarm Systems CODE OF PRACTICE FOR SYSTEM DESIGN, INSTALLATION AND SERVICING.

B. The power supply breakers for FDA system shall be marked “DO NOT DISCONNECT. FIRE ALARM SUPPLY”

ANALOGUE ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)

A. In the event of a fire being reported from the smoke/heat Detectors, activation of manual call points or sprinkler operation the sequence of alarm operation shall be as follows: If a fire condition is reported from a smoke detector then the evacuation will be done initially by the local integral sounder. Then after a certain delay (to be agreed at the time of commissioning) the evacuation message shall be announced on that fire zone only. If after 3 minutes the alarm has not been acknowledged, the evacuation message shall also be announced on the other adjacent zones. All other zones shall be given the Alert message. The evacuation of the building shall be staged in phases to allow orderly movement of people.

B. If a Manual Break Glass Unit is activated or a sprinkler flow switch is operated,
then the evacuation shall be transmitted immediately to the affected fire zone plus the adjacent zones.

C. Activation of the fire alarm system shall directly initiate some or all of the following to be agreed as a part of the overall engineering policy.

- Signal to all elevator machine rooms indicating fire status (to control lifts)
- Release doors normally locked by magnetic devices.
- Release doors normally held open by magnetic devices.
- Shutdown mechanical equipment ventilation plant.
- Shutdown general exhaust fans.
- Start up smoke extract fans.
- Start up exhaust make up fans.
- Start up stair vestibule pressurization fans.
- Automatically operate fire dampers.
- Initiate alert signals to panels in the adjacent office tower.
- Sprinkler valves, flow switches and other monitored valves shall be directly supervised by the fire alarm systems.

These shall include but not limited to the following:

- Building automation system via WINMAG OPC
- Emergency lighting system
- Security system.

SYSTEM COMPONENTS AND DEVICES

FIRE ALARM CONTROL PANEL:

A. The panel shall be modular Multifunctional computer controlled using 32 bit processor. De-centralised control and monitoring functions to be realised on the loop and spur. The panel shall be complete with, but not limited to, the following elements:

1) Visual display unit capable of displaying 8 lines 40 characters backlit display / 1/4 VGA display as optional.
2) Built-in optional 40 character internalprotocol thermal printer or external.
3) Built-in full numeric keyboard with function keys.
4) 64 Single Zone Indicator expandable upto 192 SZI
5) USB Port
6) Ethernet connection
7) SMART Card media slot.
8) Keyswitch to prevent unauthorised operation of keypad.
9) Integral sealed lead acid battery and charger, with 24 hour back up in the event of supply mains failure.
10) Essential controls – Delay, panel reset, Audible alarm off, Disconnect master box, additional messages, verify/cancel fault buzzer. Fire, Pre-Alarm, Trouble, Disconnection lamps. Each lamp shall also have appropriate indication (Releasing Systems activated, Master box, Delay , Verify, CPU failure, Inoperation normal condition & failure of powersupply / battery) Simple menu driven function keys with password protection shall allow users to an extensive range of software based features such as:

- Overview
- Service
- Time functions
- Informations
- Last 10000 system events
- Current fault and warning logs.
- Interrogation of sensor cleanliness
- On/Off, Enable/ disable sensors, zones, sounders, interface unit channels.
- Status of detectors
- Alarm counters
- Printer on, off, line feed and test facilities.

11) All control buttons and keyboard shall be enclosed behind a lockable cover, Up to 127 device capacity per 3.5km loop and a TTY/ RS 485 communication option.

12) In addition to the above, all other necessary controls, elements and accessories shall be included to provide a complete and efficient panel conforming to the requirements of DIN EN 54/UL.

13) LOOP PARAMETERS:

Individual loop circuits will be capable of accommodating the following.
- Up to a maximum of 127 addressable devices up to 3.5 kms loop length
- Up to 32 loop powered IQ8 Alarm addressable Sounders.
- Up to 32 loop powered IQ8 Alarm electronic Strobes.
- Up to 32 loop powered combined electronic sounders and strobes
- Up to 80 sensors with integral alarm sounder
- The detection loop shall have the ability to support both sensors and sounders connected on the same 2 core loop circuit.
- Up to 127 loop powered input modules.
- Should have the ability to spur off the detection loop without using ‘T’ breaker devices, without any degradation.

CENTRAL GRAPHICS SUPERVISOR COMPUTER:

The graphic visual display shall pictorially represent Fire, Fault and Emergency events on a visual display unit (VDU). The purpose of this facility shall be to provide the operator with the additional visual information over and above the text provided. All system events i.e. fire, fault and warning shall be automatically printed onto the graphics printer. Operation of the graphics terminal shall normally be by selection of the appropriate pages guided by a navigation system. However, it shall automatically track to the relevant initiating device for the first occurrence of each type of the event. The graphics terminal shall provide the following:

- DUAL LANGUAGE ENGLISH / ARABIC.
- Single Station version
- Multi Station Version
- Multi Networks
- Modem Interface
- Communications shall be bi-directional
- Free programming of alarm programs and alarm condition through SIA programming

Software shall have software interface using drivers with:
- Intruder Alarm Panels
- Fire Alarm Panels
- Video System
- Access Control System

Web Function: PC on Intranet/Internet using a common Web-browser shall be able to access the software with password.

Notification: Software shall be capable of transmitting text and voice messages to specific devices like cell phones, pagers etc.

Escalation: Software shall be capable of starting escalation action if within certain/configured time period the notification is not acknowledged.
Integration of IP telephony shall be possible at least with ALCATEL to have innovative linking of telephony via IQphone enabling the end-user devices to be used as multifunctional operating and display terminals with variable adaptation of applications.

HTML View: Applications such as Video streaming or BMS programs which have a Web server available shall be visualised clearly by Supervisor Software browser window USING Supervisor Interface.

Events display/status bar giving a clear and concise view of the current events on the fire alarm system, Intrusion CCTV or ACCESS control.
- Ability to control and change the following:
  - Disable actions
  - Labels & Auxiliary text
  - User Action buttons
  - Historic data of all the system events
  - Access levels/passwords to target specific levels of access to specific users
  - Graphical representation (if required) of the site allowing the exact location of the fire alarm events, e.g., fires, faults etc.
  - Panel remote buzzer cancellation
  - Event acknowledgement
  - Clock synchronization with panels with local adjustment facility
  - Touch screen support

The terminal shall assign a number of different graphic pages to each fire event – from a site overview of building layout, through a floor layout, breaking the site down into increasing levels of detail. Number of graphic pages required shall be finally determined by the client/consultant. For tender assume 4 pages per floor, based on the drawings produced on AutoCAD by the Contractor.

The system shall operate on the Windows environment. The platform specification required is an IBM PC compatible with the following minimum specifications.

Pentium IV Processor, 1GHz speed
256 MB RAM, 1 GB Hard Disk
XGA-graphic card with min. 4 MB video memory
Minimum 14 super VGA color screen
Two serial ports and two parallel ports & Real time clock
3.5 inch 1.44- MB floppy disk
CD RW & Microsoft mouse

The combined text and graphics package shall be provided on the same supervisor. The supervisor with touch screen is recommended.

SYSTEM EVENT PRINTER

A. The system printer shall be 40 character thermal printer optional in-built on the main control panel, and shall log all events, change of status, alarm and fault messages along with time of the day and date. An external 80 couloumn dot matrix printer along with system PC is also recommended.

The printer shall provide the following:
- Hard copy of every event occurring
- Status read out of every addressable point
- Devices tested on a walk test
- Contaminated detectors needing replacement
FIELD DETECTION DEVICES

GENERAL: ANALOGUE DETECTORS & BASES

All analogue detectors and bases shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible.

All analogue detectors shall have real intelligence itself. This means even without control panel the detector can make decision, adapt to different environmental condition and diagnose itself. They shall have decentralized intelligence, automatic function self test, CPU failure mode, alarm and operating data memory and integrated short circuit line isolators. The detector bases for interfacing between the loop wiring and the detector head shall be manufactured by means of injection molded ABS plastic coloured white and shall not contain any electronics for addressing. All bases shall include the option to provide a programmable relay output for interfacing, providing a dry contact for third party. All bases shall be provided with a plastic removable dust cover for protection during site construction as well as an IP rated sealing gasket to prevent dirt and moisture from entering from the fixing surface. Each base shall include a lock and removal of locked detectors shall be achievable only through the use of the appropriate removal tools as specified by the manufacturer of the detectors. Detectors removal tools are to be handed over on completion of the contract as part of the spare parts to the client.

Removal of a detector from it’s associated base shall not affect the continuity of the detection loop.

The Fire alarm manufacturer shall have the complete range of following analogue ADDRESSABLE detectors with decentralized intelligence as standard so as to meet the specific applications of the site.

a) Heat Detectors (fixed & ROR temperature )
b) Optical Smoke Detector
c) Optical Smoke & Heat Detector
d) Dual angle Optical/Heat Detector
e) Blue Light Optical / Heat Smoke Detector
f) Optical Smoke, Heat & CO gas Detector
g) Manual Call Points

All of the above shall be compatible with the aforementioned base providing interchangeability between detector heads, without the requirement for switch settings. All detectors shall also have an integral short circuit isolator, which in the event of a single cable fault will isolate the “culprit” piece of cable and retain all devices on the loop operationally.

Each detector shall possess two integral LED giving a red flashing indication for fire and green for normal operation. For remote locations, each detector shall be capable of connection to a remote LED unit by means of 2 core wire connection. Detectors shall be white in colour and manufactured from ABS plastic. All electronics and associated sensing elements will be housed within this unit, these components being hermetically sealed to prevent their operation from being impaired by dust, dirt and humidity. The sensitivity off all detectors shall be adjustable from a software. It shall be possible to programme detector sensor sensitivity directly on the loop using interface with a laptop PC and appropriate programming software from manufacturer.

For MULTI SENSOR detectors, disablement of each sensor element shall be possible
individually or for whole loop. Also this disablement feature shall be possible to have manually or time / event controlled.

All detectors shall be provided with a plastic removable dust cover for protection during site construction. A semi-flush recessing kit for analogue detectors shall be available for each detector type incorporating the standard detector base.

**HEAT DETECTORS**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 and shall be VdS /UL approved. This shall be a dedicated heat only detector to provide fixed temperature heat as well as rate of rise sensing. It should be fully compliant with EN54 part 5 to provide grades of A1.

**OPTICAL SMOKE DETECTOR:**

Install as shown in the drawings. Analogue Addressable Optical Smoke Detectors. These shall be of Automatic addressable Optical type with inbuilt isolator in a single head. The optical element shall detect visible smoke from slow smoldering fires. Smoke sensing design shall comply with EN 54 part 7 and shall be VdS/UL approved. It shall have microprocessors, short-circuit isolators and all electronic components and circuitry suitable for an Analogue addressable system. The detectors shall also have 360 degree viewing LED fire indicator. Detectors mounted in the false ceilings shall be provided with semi flush mounting kits.

**OPTICAL SMOKE /HEAT DETECTOR**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7 and shall be VdS/UL approved. This device shall combine two individual sensing elements to provide excellent cover for both types of fires (slow smoldering & fast free burning fires). These detectors shall be of Automatic addressable Combined Optical/Heat type with inbuilt isolator in a single head. Optical sensing shall be carried out by means of an Infra-red LED transmitting a pulse of light across an obtuse angled chamber & heat sensing shall be carried out by a thermistor, sampling the surrounding environmental temperature.

**DUAL ANGLE OPTICAL/HEAT DETECTOR**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7 and shall be VdS/UL approved. This device shall combine two individual sensing elements to provide excellent cover for both “types” of fires. (Slow smouldering and fast free burning). OPTICAL SENSING: Shall be carried out by 2 infra-red LED transmitters across 2 separate Optical detection angles. This sensor shall process both the forward and backward scattered Light caused by entering the detection chamber of device, allowing the detector to Differentiate between real smoke and non-smoke particles e.g. Steam & Dust.

HEAT SENSING: Shall be carried out by a thermistor, sampling the surrounding environmental temperature.

**OPTICAL SMOKE / HEAT / CO DETECTOR**

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 & 7. The sensor element of the optical/heat detector with CO shall be as per the specification for the optical/heat detector. The CO element shall be incorporated into the optical chamber to sense the presence of carbon monoxide gas emissions from smouldering fires. In normal environments the CO element shall have a life expectancy of a minimum of 5 years.
MANUAL CALL POINTS

Install as shown in the drawings. The manual initiation devices shall be electrically compatible with all of the aforementioned detector types and shall be complete with all electronic components and circuitry for an automatic safe addressable device. The manual call point shall have an inbuilt short circuit isolator and an inbuilt microprocessor to ensure a response time of less than 1 second.

The MCP unit shall also handle all communication to the control panel. All electronic devices contained within the MCP shall be hermetically sealed so as to prevent damage from hostile environment conditions: e.g. dust with minimum rating of IP43.

The MCP operating voltage shall be 8-42 volts DC, RED similar to RAL 3020. If the MCP are located in public areas a transparent cover shall be provided as a protection tp prevent inadvertent activation. MCP shall be available in two designs Large & small for aesthetic purposes to architects.

The MCP shall have an input facility to connect conventional devices. It should have an option of using either frangible glass allowing for complete removal upon operation or plastic pane resettable function. There shall be no text but SYMBOLS on the MCP ( burning house / press to break ).

The device can be tested functionally without the need to either remove the front cover and/or breaking the glass, with a special test key (supplied as standard). The key shall insert the underside of the MCP ensuring easy access of the key at all times.

These devices will comply fully with EN 54 part 1.

FIELD ALARM DEVICES

Electronic sounders, combined sounder/strobe and standalone strobes shall be loop powered for direct connection to the 2 core detection loop shall be electrically compatible with all initiation devices. These wall mounted units shall be available in red or white and suitable for both indoor and outdoor applications with an ingress protection rating of IP31 and IP65 respectively.

All electronic sounders, sounder/strobe and strobe only versions shall have alarm signals synchronized across all the detection loops of the fire alarm control panel.

All alarm devices shall have a short circuit isolation device provided as an integral component of the device.

All sounders shall have a ‘soft start’ feature controlled by the fire alarm panel, whereby a low initial volume can be set and then increased at a defined rate upto a maximum volume setting.

All alarm devices shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible The Fire alarm manufacturer shall have the complete range of following alarm devices with built in short circuit line isolators so as to meet the specific applications of the site.

a) Addressable Sounder
b) Addressable Flasher
c) Addressable Sounder / Flasher
d) Addressable Speech Sounder
e) Addressable Sounder / Flasher / Speech
ADDRESSABLE ALARM SOUNDER

Alarm sounders shall be capable of providing a minimum sound level of 97dBA ± 2 dBA @ 1 meter.

The sounder shall be capable of providing 4 different sound signals, which are selected/configured from 19 tone types stored in the device.

Each sounder shall include its own microprocessor to handle loop communications and monitoring of the internal sound element during an alarm condition. This shall allow faulty devices to be automatically identified during the weekly test procedure. All associated electronic components shall be hermetically sealed to provide protection from hostile operating environments.

It shall be possible to connect up to 32 Addressable Alarm sounders to each detection loop of the fire alarm control panel. These devices will comply fully with EN 54 part 3.

FIELD INTERFACE TRANSPONDERS

These devices shall be directly connected to the loop, four variants shall be available as standard, these being:

(i) 4 In / 2 Out interface unit
(ii) 1 In interface unit
(iii) 32 LED output interface unit
(iv) 12 Relay output Interface unit.

These units shall be self-contained wall mountable units, similar in finish to the main control panel.

(i) 4 In / 2 Out interface unit

Interface units shall be capable of accepting 4 input signals, 2 output signals. Dependent upon the specific application, input signals may be interpreted by the system as any of the following:

- Fire signal input
- Fault signal input
- Supervisory signal input
- Event signal input

The exact nature of which shall be selected by means of the commissioning software. These units will accept and or supply clean contact signals either normally open or normally closed (configurable) OR switched voltage inputs from conventional detectors or MCP's.

The output contacts shall be rated at 30V / 1 amp. DC output of the unit shall be provided with single pole change over contacts for control of plant, door release units or power output to drive conventional bells, sounders etc. Both the outputs on the interface shall be individually programmable. External power supply 12V / 24 VDC shall be provided to this unit.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications. Product shall be approved by VdS.
(ii) **1In interface unit**

Interface units shall be capable of accepting 1 input signal. Dependent upon the specific application, input signals may be interpreted by the system as any of the following:

- Fire signal input
- Fault signal input
- Supervisory signal input
- Event signal input

The exact nature of which shall be selected by means of the commissioning software. These units will accept and or supply clean contact signals only, either normally open or normally closed (configurable). No switched voltage inputs or outputs will be accepted.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications.

(iii) **32-LED output interface units**

These interface units contain 32 outputs for triggering LEDs of e.g. mimic panels. Each output can be freely programmed with the commissioning software. The outputs are selectable as positive or negative signals. There shall be possibility to test the outputs/LEDs manually with e.g. a button.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications.

(iv) **12-Relay output interface units**

These interface units contain 12 clean relays which are individually programmable with the commissioning software. All relays can be configured as NO or NC.

As with other outstations previously mentioned, interface units will contain local processing in order to handle all signalling and loop communications.

**NETWORKING OF CONTROL PANELS**

It shall be possible to network connect up to 31 controls as a secure network connection. All messages from a panel should be transmitted in both direction on the ring structure. Any wire-break or short-circuit on the ring shall not effect data transmission. The network shall be configurable so that single panels, groups of panels or all panels on the network operate the same site configured cause and effect fire plan.

The network shall also be configured to allow master control from any one of the control panels on the network. To cover longer distance repeaters or fibre optical cable and converters can be used between two panels.

The network shall be able to accommodate intruder alarm panels.

There shall be extensive diagnostic functions on the panel to be used to localise faults caused by interference or wiring. Networking shall be capable of carrying out using a datacable e.g IBM type 1 or CAT5. The distance between each panel shall be standard 1200 meters and capable of extending upto 3000 meters using booster repeaters.
NETWORKE PK LCD OPERATING PANELS / REPEATER PANELS

The Repeat Panel shall be sited at the Rear Entrance, guard house or location where it is manned 24 hrs. It shall provide system repeat facilities to repeat all of the liquid crystal display messages as well as the common indications. Repeat panel shall be interfaced for network fire alarm control panels, designed for standardised display and operatio as per DIN EN 54 part 2 and DIN VDE 0833 part 2. Installation and connection to FACP shall be via the short circuit and open circuit resistant essernet. System network, RS 485 interface or TTY interface for connecting remote printers, and fire brigade shall be available. The repeaters shall have minimum three common relays freely programmable, monitored, potenti Ray free.

BATTERIES:

Batteries shall be provided and shall be the dry sealed lead-acid type. The batteries shall have ample capacity. With primary power disconnected, to operate the fire alarm system for a period of 24 hours with an optional 72 hours battery backup. Following this period of operation via batteries. The batteries shall have ample capacity to operate all components of the system, including all alarm signalling devices in the total alarm mode for a minimum period of 30 minutes.

WIRING

All cables associated with Fire Alarm installation shall be of fire resistant 2 core 1.5 sq. mm twisted pair. Cables shall comply with BS 6207 Part 1. The cable is to BS 6207: Part 1 having, Typically no more than 2 cores each core having 1.5 sq. mm cross sectional area, A red cover sheath (preferred for alarm applications), Having continuous metal sheath encapsulation, Fire resistant tested to BS6387 categories CWZ.

INSTALLATIONS

The entire fire alarm system shall be installed in accordance with DIN / BS EN54 /NFPA Standards and manufacturer’s approved shop drawings, written instructions and recommendations.

TESTING

Fire alarm system shall be tested in accordance to Local Civil Defence regulations and put into operation by the manufacturer or his authorized representative in the presence of engineer. Fault and alarm conditions shall be simulated and all data and alarm indicators checked with full events recorded on system printer according to the testing procedure.

APPROVED MANUFACTURERS

Acceptable Manufacturers shall be

approved either by EN 54/VDS/UL
approved by the Local Civil Defense
and subject to total compliance with the above specifications
3.8.1 **INVERTER**

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Input</td>
<td>180 TO 270 Volts</td>
</tr>
<tr>
<td>b) Output Voltage:-</td>
<td></td>
</tr>
<tr>
<td>Mains</td>
<td>As per incoming Voltage</td>
</tr>
<tr>
<td>Inverter</td>
<td>220V Nominal</td>
</tr>
<tr>
<td>c) Output Frequency:-</td>
<td></td>
</tr>
<tr>
<td>Mains</td>
<td>As per incoming Frequency</td>
</tr>
<tr>
<td>Inverter</td>
<td>50 Hz ± 1%</td>
</tr>
<tr>
<td>d) Output Wave Form:-</td>
<td></td>
</tr>
<tr>
<td>Mains</td>
<td>Sine Wave</td>
</tr>
<tr>
<td>Inverter</td>
<td>Stepped approximate to Sine wave</td>
</tr>
<tr>
<td>e) Overall Efficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum 90%</td>
</tr>
<tr>
<td>f) Power Factor</td>
<td>0.8</td>
</tr>
<tr>
<td>g) Back up Time</td>
<td>30 Minute on full load</td>
</tr>
</tbody>
</table>

**BUILT IN ELECTRONIC PROTECTION**

Reverse Battery polarity protection shall be provided with an audio signal. Electronic Controller shall prevent overcharging or deep discharge of batteries. The unit shall be protected against overload, short circuit and reverse phase connection. Isolators shall be provided at the mains and battery inputs for instances of short circuits.

**FILTERS**

Suitable filters shall be provided inside the inverter to prevent damage to lighting fixtures and to avoid noise generation.

**COMPONENTS RATING**

All the components including the Transformer shall be of 24 hour rating.

**TECHNOLOGY**

MOSFETS shall be used for switching devices. The charging of batteries shall be SCR Controlled giving Constant charging for the entire input voltage range of 170-270 Volts.

**TESTING AND COMMISSIONING**

i) **Back-up Time**

This should be measured with a fully charged battery (same Voltage and specific gravity). The cut-off voltage should be taken as 10 Volts per battery system on the inverter side. The same load should be connected to each equipment to be tested and any unusual level of noise in fans should be recorded.

ii) **Low battery Cut off**

The battery should not be discharged below 10 Volts. When the inverter is ON and the battery has discharged to this voltage, it should automatically switch off. This control is a must because if the battery is allowed to discharge further it will become deep discharged and its life will drastically reduce.

iii) **Reverse Polarity Protection**

This protection is normally required when untrained persons do installation. However, many times this protection is provided in such a way that it does not allow a battery, which has gone very low to be charged. Even if the battery
voltage has gone down to 6 volts, the system should come on and the batteries should be charged without calling the technicians.

iv) **Charging Current**
With a fully discharged battery, at 10 Volts, during the entire AC mains voltage range of 180 to 270 Volts the charging current should be nearly constant and should not exceed 6% of the AH rating of the battery. When the battery is fully charged (approx. 14.2 Volts), the inverter should go into trickle charge with the charging rate not exceeding 1% of the AH rating of the battery. During the testing, by adjusting the input voltage, the charging should be done at the highest rate and the battery temperature measured. The maximum charging rate and the maximum temperature permitted by the battery manufacturers should be compared with the readings obtained.

v) **Transformer**
The temperature rise of the transformer during the charging and inverter phases should be measured. If the temperature goes beyond 105 degrees Centigrade, the transformer insulation will start to become brittle and will breakdown after a year or so.

vi) **Output Voltage**
For proper functioning of the equipment, for most of the time, the output voltage should remain between 200-220 Volts. It should not drop below 185 Volts under any circumstances. It should be possible to switch on tube-lights even when the other load is on.

vii) **Wave form**
The inverter output wave form should be observed to find out if it has spikes and whether it is square or has been filtered for necessary protection to the equipment.

### 3.9 EPABX SYSTEM-

The bidder must be an OEM OR JV partner with the OEM with 25% equity participation OR Bidder should produce an undertaking from OEM in the name of client that the bidder is authorized to quote and will provide support & spares directly or indirectly for the offered system for the next 10 years. Further the OEM should also state that the offered system is latest system being manufactured by it.

1. The bidder must provide a list of customers with complete contact numbers, contact person name where they have commissioned similar type of EPABX.

2. The bidder should be able to demonstrate advance features/ solutions (those have been complied/ claimed) running in their system in this region on short notice. Features include (QSIG, IP telephony, remote shelf etc).

3. Valid TEC Approval for IP PBX under TEC specification number IR/PPX/-01/02. DEC’2004(IP PBX for Private use) for the Make & model quoted should be submitted along with offer for, TEC should be for 12000 IP users.

4. Offered exchange should be field proven & reputed make. Brand should be in India for at least 10 Years. Necessary documentation to this regard must be submitted.

5. The offered exchange of should have been interfaced to BSNL/ MTNL in at least 3 locations & should have been working satisfactorily. Details of executing similar type of works shall be furnished as per attached schedule.

7. The OEM should be a member of ECMA and IPNS. Test Certificates with other make exchanges certifying demo of QSIG should be attached.

8. Any Government body in India should not have blacklist the bidder or it's subsidiary, dealing in similar products.

9. The firm should have adequate financial stability & status to meet the financial obligations of the scope of work & have a turnover of at least 15 crores from the same business during last 3 years. The bidder should submit their Profit & loss statements for the last three years.

**TECHNICAL SPECIFICATIONS FOR EPABX SYSTEM**

**GENERAL**

The specifications mentioned in the tender document are intended for the EPABX system.

**EXCHANGE SPECIFICATIONS**

The proposed IP EPABX system should be 100% Non-blocking switching system with ISDN/ATM compatibility. (Integrated Services Digital Network/Asynchronous Transfer Mode), configured for:

- Analog Extensions with CLIP,
- Digital Extensions,
- P&T Lines, expandable up to 10,000 Extensions.

The system should support A as well as mu law and support following compression standards on audio


Valid TEC Approval for the Make & model quoted in the name of the bidder should be submitted along with offer for: TEC should be for 12000 IP users.

The proposed IP EPABX switching technique should be confirming to latest ITU-T and CCITT standards. The EPABX should function in hot-standby duplicated configuration for all control cards and ringer section.

The system should provide complete Non-blocking digital path for Voice and Data Communication (IP Protocol). The system should also offer an in-built Ethernet port management.

**SYSTEM ARCHITECTURE**

The offered system should be modular in design. The architecture of the EPABX should be capable of seamless migration to its maximum capacity by simply adding peripheral cards on the same set of control cards & CPU without compromising on any function /features of this system or any degradation of service.

The proposed system should follow the principle of convergence and accordingly the control should in CPCI architecture.

The system topology should be fully duplicated in terms of time slot, tone, clock highways power supply and processor. It should be based on decentralized control.

The EPABX should support linking of Homogeneous EPABX over IP with full feature transparency (distributed architecture) & IP Remote Shelf (Access points). IP Access points should be centrally administrable from the host system. Adequate details shall be furnished.

Distributed switching should be possible on IP Access points (IP Remote Shelf) also.
The system should have Universal ports for line/trunk cards. Wherein any peripheral card can be inserted in any slot of the peripheral shelf, thereby enhancing the flexibility of the configuration.

**CENTRAL PROCESSING UNIT**

The Central Processing Unit of the EPABX should be a 32 Bt Hierarchical Pentium based microprocessor with fully distributed controls, offering hot standby configuration with transparent switchover without disconnection of calls on occurrence of fault, covering all control cards etc.

The processed system should have the ability of Busy Hour Call Attempt (BHCA) of above 200000.

**STORAGE MEDIA**

The system should provide world’s latest technique of storage media (Flash EPROM or Magnetic Optical disk for higher reliability and fast booting). Please mention the storage media used for Main Memory & standby memory.

**TRUNKS**

ISDN (INTEGRATED SERVICES DIGITAL NETWORK): The offered exchange should be an ISDN ready switch. The system platform should be ready for ISDN and only the necessary ISDN BRI & PRI cards (Basic Rate Interface & Primary Rate Interface) need to be added for functionality (Please refer to Bill of Quantity if the requisite cards are required at present).

The system should be capable of accepting different types of signals for E1, ISDN (BRI & PRI), Ring down, 2W/4W E&M signaling etc.

The system should support EI (30 channel PCM) level DID.

The system should have IP trunks on H.323 standards as well as SIP trunks. SIP should be supported on standard RFC3261. The system should provide SIP subscribers and SIP trunks on the same interface.

The system should support E1 & PRI on the same card. These cards should have dual (2x30 channel) modularity.

The digital card should directly take on monomode /multimode fiber on the E1 interface without use of any external device such as Optimux. External fiber interface to system shall not be acceptable.

**DUPICATION**

**System Redundancy:** The system should be provided with 100% Duplicated Control Unit in Hot standby mode. The following Duplication should be provided with the system for:

(i) Common Control
(ii) Switching Network
(iii) Tones
(iv) Main and standby memory

Redundancy: The system should provide complete set of control cards duplication. In case of failure of one processor card the duplicated card should take over immediately with the current database, on which the system is working, without the disconnection of established calls.

The offered system should be capable of Hot Swapping of all cards without switching off the system where the necessary cards can be interchanged or replaced even in online conditions.
It should be possible to reach the ultimate capacity (10000 ports) of the switch without any upgradation of the CPU & need of additional CPU’s.

OPERATING SYSTEM

The operating system of the EPABX should be UNIX based and protected against loss/alteration of memory due to power failure/unauthorized command or due to any other faulty condition.

REMOTE SHELF

Remote shelf should be supported on Optical Fiber
A single remote shelf should support 256 channels between the main system & single remote shelf, on Optical Fiber cable.
Remote Shelf’s should also be supported on IP.
IP remote shelf’s should be available in 19” rack mountable shelf.
High voice quality for IP-based access points based on mechanism such as Echo cancellation, Voice Compression G.729A with 8 kbps, and Silence Suppression, Quality of Service Support via IP Network by traffic prioritization: IEEE 802.1 d/q and IETF DiffServ.
Remote shelf’s should be centrally administrable from the host system.

HIGH QUALITY SIGNALING

The system should provide high quality signaling earth (less than 2 ohms).

CTI APPLICATIONS

The offered system should support Computer Supported Telephone Applications (CSTA) in order to facilitate integration of LAN and IVRS.
The offered system should support CTI applications (Computer Telephony Integration) for features like Screen Popup through CLI or DNIS (Dialed Number Identification Service).
CTI should support for all 3rd party CTI solutions Call Path SeRver/2 CallPath Server 6000, CallPath SeRver/2 CallPath Server 6000, Microsoft client/server TAPI, Novell TSAPI.

VOICE MAIL

The PC based voice mail should be the same make as that of the PBX system. No external third party voice mail will be accepted. The offered voice mail system should be capable of integrating with the existing LAN/WAN and upgradable to unified communication solution (Integration of Voice mail / Fax mail / video conferencing / web conferencing etc to name a few). Users should be able to access the system internally or remotely from any phone & should be able to record standard/ personal greetings within the mailbox. The system should be able to inform the outside caller about the exact status of the desired extension (no answer/ busy). The System should also support recording of name and personalized greeting within each mailbox. System administration should be user friendly and the system should be windows based. The application development tool, which allows call flow transaction to be written & modified at site using simple menu driven command. The on line updating, changes / modification in application should be dynamically loaded/ assigned without switching off or disturbing the services.

CONFERENCE

It should be possible for extensions users up to maximum of 8 users with any combination of internal stations and also Tie Lines to talk to each other at the same time on the conference circuit. The conference call may be facility-actuated by one of the extension users or by any attendant. Multiple 8 party conferences should be supported. Minimum 100 conferencing circuits should be available in the quoted price.
10/100 MBPS LAN Connectivity: The system should support a 10 Mbps LAN connectivity, which is to be used for maintenance configuration of the exchange.

**ATM.** The system should support Asynchronous Transfer Mode (ATM) by the addition of a card which resides into the system. It should be possible to use for ATM networking i.e. the implementation of PBX networks via ATM Permanent Virtual Connections (PVC) and/or ATM Switched Virtual Connections (SVC). Details of ATM card available should be furnished. The system should support UNI 4.0

**Voice Over IP.** The system should support voice over IP (VOIP) applications with additional hardware. The system should support integrated in built IP Gateway. Is it possible to connect IP Phones/soft phones to the offered EPABX on H.323 standard as well as SIP

**Loop Resistance:** The offered system should support loop resistance for subscriber’s 1700 ohms excluding telephone sets.

**Music On Hold:** The system should support inbuilt music on Hold. It should also be able to Interface with an external Music system i.e. CD Player etc. The system should have Emergency transfer to predefined CO lines in case of power failure.

**PAGING & CELLULAR SYSTEM**

The offered system should support integrated DECT solution. Further the system should be capable of integrating with captive and public paging systems.

**NETWORKING**

The offered system should work under the internationally recognized Networking protocol, QSIG. The OEM should be the member of ITSI and ECMA and IPNS forum. This is must. Bidder should also submit the required documents in support of the above qualifying criteria. Bidder should also submit documents pertaining to interworking with other exchanges.

The offered system will be equipped with a external call metering facility, fully integrated with the system.

The system should be capable of integrating with DOT approved CEPT (2MBPS) cards of Direct Inward Dialing and also for connectivity with other exchanges.

Vender should include the cost of QSIG software in the system price.

The system should support the following minimum signaling & interfaces like E&M, 2 MB CEPT, R2MFC (Digital, Analog), ISDN BRI/ PRI, TSAPI, TAPI, IP Trunking, IP Gateway, ATM, LD & QSIG etc.

**DECT:** The IP PBX system should support DECT (Digital Enhanced Cordless Telephony).

**OPERATOR CONSOLE:** IP PC based operator console maximum no of IP PC Based operator Consoles should be 16.

IP PBX should have BLF (Busy Lamp Field) for ease of operation which will increase the efficiency of the operators.

IP PBX should have directory for user data base.

**MAINTENANCE CONSOLE**

The offered system should be provided with a PC based and software up-gradable maintenance console.
The system should be provided with a maintenance panel for command input and status display.

The system should have the compatibility to connect an external PC for maintenance programming.

The visual indications of the faults should be available at the Maintenance Console in terms of messages.

The system should support remote fault diagnosis up to card level.

Call statistic reports as required by the user should be available on the monitor as well as printouts. The formats of printouts should be programmable.

DIAGNOSTIC AND MAINTENANCE FACILITY

The system should have inbuilt diagnostic features such as isolation/detection of faulty line/junction and restoration of faulty lines/junctions after rectification.

The offered system should have remote maintenance facility using dial up connection for remote maintenance with proper password protections.

It should be possible to maintain the system over LAN.

The EPABX should have auto restart capability to automatically reload the system software after system power is restored to it.

The system should have online tracing facility on ISDN interface.

**PC for Voice Mail, Maintenance Console & Call Billing and Operator Console.** (Compaq / IBM with Original Windows 2000 License):

- Intel Core Duo
- HDD – 80 Gb
- RAM- 1 GB
- 52 X CD ROM with Multimedia
- Keyboard
- Mouse
- 17” TFT Colour Monitor
- Speakers
- 4 no’s of PC required

SUBSCRIBERS FACILITIES

The system should have the capability for tracing malicious calls.

The system should offer two way splitting of calls.

The system should provide the facility of 3 party conferences. In addition, the system should have the provision of multiple 8 party simultaneous conferences involving any kind of trunk or extension.

The offered system should have the capability of assigning to each extension a variety of specified services. Further Class of service restriction should be available to the subscribers.

Call forwarding should be available in the offered system.

The offered system should provide one no service so that the calls are always attended.

The system should support abbreviated dialing system for at least 100 numbers.
The offered system should also support multiple individual dialing groups as abbreviated dialing system.

The system should be capable of allowing the users to access all the facilities from any extension of the EPABX.

The system should allow user to assign passwords to their phones to prevent misuse of subscribers facilities provided.

Discriminative Ringing for extension calls, trunk calls, Special feature calls etc should be available.

Least Call Routing through alternate public networks on different time of day basis.

Night Service: When Night service is activated the operator calls should be routed to predefined answering positions.

The offered system should have the following other features for the subscribers as below:

- Line lockout
- Hot line
- Attendant recall
- Call forwarding preset/busy/no answer
- Call hunting
- Howler tone
- Automatic call back
- Call waiting
- Station camp on ringing
- Hunting method change for each type of calls
- Recorder tone
- DND (Do Not Disturb)
- DND (Do Not Disturb Override)
- Variable presentable time out for Co line, Trunk lines
- Tie lines
- Consultation hold
- Call pick up
- Call parking and retrieve
- Extension grouping/intercom barring
- Fixed and delayed call forwarding
- Storage of last number dialed
- Discriminative Ringing
- Moving class of Service
- Group to Group restriction

**POWER SUPPLY**

Power Consumption of the exchange at full traffic conditions should be as low as possible. Bidders shall specify the power consumption in their offer.

A SMPS based Float cum Boost charger (FCBC) of suitable rating should be supplied, to provide the required voltage from the AC supply to the EPABX.

The offered system should be provided with maintenance free sealed batteries which can give a backup for a minimum of 04 hours.

The system should be provided with supervisory alarms for the mains failure.

Adequate protection should be provided for the system against fire & electric shocks.
The system should have an operating voltage 48 volts DC.

**HIGH QUALITY EARTH**

The resistance for the system should be limited to under 2 ohms.

The system should be provided with the necessary lightning protection as per ITU recommendations.

**LIFE CYCLE**

The offered exchange should have a life cycle of 10 years atleast. Letter from OEM should be enclosed.

**OPERATING AMBIENT CONDITIONS:**

The offered system will be able to operate in ambient temperature range +5 to +45 degrees Celsius.

The system should be able to operate in relative humidity of about 30-80%.

**Push Button Telephones with CLI facility**

10 repertory Keys  
Last Number Redial  
Hands free duplex  
Ringer, volume adjustable (high, low), Mute  
Without external power or batteries  
Pulse or tone dialing, temporary switch over possible  
Recall key (2 flash times switchable)  
Hearing aid compatibility conforming to CCITT P

**Digital Phones:** The digital Phones should have the following features

06 Line display  
USB port for CTI interface  
Fully duplex  
Menu Navigating Keys  
Min 06 Programmable  
Adapter position for ISDN/ Analog Phone/ digital phone Interface  
Support for Master slave configuration  
Caller name display  
Time display  
Automatic Call back  
Adapters that should be supported: ISDN/ Analog/ digital

**Call Billing Software:** The system should come along with a windows based call billing software which supports detailed call information on all outgoing & incoming calls on trunks/ trunk groups, extensions. The records should be flexible to allow customization.

**IP Phone**

2 x 24 Character Tiltable Display for TYPE -1 & 06 line display for TYPE -2  
Control keys  
Navigator for Interactive user prompts  
Handsfree Operation with at least 07 fixed function keys  
Support for H.323 standards and SIP  
Support for Audio Codecs G.711 & G.723.1  
Support for Quality of Service  
Support Security H.235 protocol at the work point level  
Support Power over LAN + 2 port-Mini Switch -> „One wire to the desk“
4 MODE OF MEASUREMENT

The following measurement code shall apply to the Contract:

4.1 BUS DUCT:

a) Bus Duct shall be measured on linear basis in meters.
b) Bends, Expansion Joint etc. shall be measured along the centre line bus duct.
c) No extra price shall be paid on account of structural supports required for Bus Duct Installation.

4.2 POWER AND CONTROLS CABLES:

1. All power cables / controls cables shall be measured on linear basis in meters.

4.3 CABLE TRAY WORK:

a) The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

4.4 STRUCTURAL SUPPORTS:

No extra price shall be paid on account of structural supports required for Electrical Panel Installation etc.

4.5 PIPING WORK:

a) The length of piping accessories & fittings shall be measured along its centre line in meters and no measurements for bends, elbows, tees etc. shall be made. All such fittings / accessories shall be treated as part of the piping work.
b) Flanges shall not be measured, as they form part of piping work.
c) For thermometer wells & pressure gauge sockets no measurement shall be done separately.
d) All kinds of supports, hangers etc shall be part of piping work & no extra measurements shall be done.
e) No additional price for installation of purge & de-scaling valves as required at site shall be paid.
4.6 INSULATION:

4.6.1 INSULATION OF EXHAUST PIPES:

i) Insulation of pipes shall be measured in terms of linear length of pipe for each size.

ii) For insulation of bends, elbows, tees etc. it shall be measured along with the center line of insulation and shall be measured in meters or shall be measured in sq. meter.

iii) Insulation of valves shall be separately accounted as per bill of quantities.

Note:- The items not specified above or not specified in BOQ & Specification but technically required shall be part of that particular equipment / material.

End of Section – 04
## LIST OF APPROVED MAKES FOR ELECTRICAL WORKS

Make indicated in the under mentioned list of Approved Makes is for general guidance of contractor. Final choice of make & model out of List of Approved Makes shall be of Architect/Consultant/Owner.

<table>
<thead>
<tr>
<th>ITEM No.</th>
<th>DETAILS OF MATERIALS</th>
<th>MANUFACTURERS NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) ELECTRICAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Moulded Case Circuit Breaker with rotary operating handle.</td>
<td>- Schenider&lt;br&gt;- Legrand&lt;br&gt;- L &amp; T&lt;br&gt;- ABB</td>
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<td>3. Switch Disconnector Fuse Unit</td>
<td>- ABB&lt;br&gt;- Schenider&lt;br&gt;- L &amp; T</td>
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<td>4. HRC Fuses with fittings</td>
<td>- L &amp; T&lt;br&gt;- Schenider&lt;br&gt;- ABB</td>
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<td>- Schenider&lt;br&gt;- ABB&lt;br&gt;- L &amp; T&lt;br&gt;- Legrand</td>
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<td>6. Voltmeter &amp; Ammeter</td>
<td>- Conzerve&lt;br&gt;- Enersol&lt;br&gt;- Secure&lt;br&gt;- Elmeasure</td>
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<td>7. Selector Switch</td>
<td>- Kaycee&lt;br&gt;- L &amp; T</td>
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<td>8. Current Transformer</td>
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<td>9. Indicating Lamp</td>
<td>- L &amp; T&lt;br&gt;- Siemens&lt;br&gt;- Vaishno</td>
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<td>13.</td>
<td>L.T. Cable</td>
<td>Polycab, KEI, Batra Henlay</td>
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<td>Schenider, L &amp; T, Siemens</td>
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<td>Cable Lug (Tinned Copper)</td>
<td>Dowells, Multi, Capital</td>
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<td>Peeco, Commet, Gripwell, Power</td>
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<td>18.</td>
<td>Cable Tray / Raceway</td>
<td>Pilco, CTM Engineers, KME</td>
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<td>19.</td>
<td>Energy Analyser Meter</td>
<td>Conzerve, Elmeasure, Enersol</td>
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<td>Voltmeter &amp; Ammeter</td>
<td>Conzerve, Elmeasure, Enersol</td>
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<td>22.</td>
<td>PVC Insulated copper conductor single core Stranded wires of 650/1100 volt grade</td>
<td>Lapp, KEI, Finolex</td>
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<td>Telephone Tag Block</td>
<td>Krone, TVS R&amp;M</td>
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<td>24.</td>
<td>M.S. Conduit</td>
<td>BEC, AKG, RMCON</td>
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<td>Esser By Honeywell</td>
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<td>Siemens (Fire Finder)</td>
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40. Lightning Protection - Erico  
- Indelec  
- LPI  
41. Earthing - JMV  
- Ashlok  
42. RCC Hume Pipe - Daya Spun Pipe  
- J K Spun Pipe  
- K K Spun pipe  
43. Telephone / Co axial Wire - Polycab  
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- Havells  
44. Desk Top - HP  
- Dell  
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46. Magnetic Lock - Capture  
- Trimec  
- Algatec  
47. Professional LED Panel - Panasonic  
- Sharp  
- NEC  
58. INVERTER - Matrix  
- Sukam  
- Luminous  

Note:-  
1. The Architect/Consultant shall have rights to change/adopt equipment makes/brands etc.  
2. These are proposed make, final Approval of these make shall be by NTPC/ EPIL.

End of Section - 05

6  EXCLUDED ITEM FROM THE SCOPE OF ELECTRICAL CONTRACTOR

a) Housing of equipments.  
b) Foundations of all equipments, supporting structure etc.  
c) Any kind of masonry work such as making of masonry trench, opening in wall / slab etc.  
d) Power and water for erection, testing and commissioning of the Electrical System.

End of Section - 06
TECHNICAL SPECIFICATIONS
PLUMBING & FIRE-FIGHTING WORKS
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Technical Specifications for Plumbing, Fire Fighting & Medical Gas System (MGS) Works - vi -
1 SCOPE OF WORK

- 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 Plumbing/Fire fighting / Hot water Generator Drawings.

- Without restricting to the generally of the foregoing shall include the following:-
  
a) Supplying & Fixing of Sanitary Fixtures.
b) Soil, Waste, Rain Water and Vent Pipes.
c) Water supply including Hot & Cold (Internal & External).
d) Pumps, & allied works for internal water supply.
e) External Sewerage system.
f) Storm Water Drainage System.

- 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 Engineer-in-Charge. If part of site is not available for any reason or there is some unavoidable delay in supply of materials stipulated by the Owner, the programme of construction shall be modified accordingly and the Contractor shall have no claim for any extras or compensation on this account.

- Works area shall be the area shown in the drawing.

2 SPECIFICATIONS

Work under this contract shall be carried out strictly in accordance with Specifications attached with the Tender & as per C.P.W.D. specifications 1996 Volumes I to VI.

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.

Works not covered as mentioned above shall be carried out as per relevant Indian Standards Specifications or Codes of Practice.

The work shall be carried out strictly as specified in Drawings & Technical Specifications. In case of any ambiguity, the details of particular item as given in specification shall supersede the details in Drawings.
3 EXECUTION OF WORK

The work shall be carried out in conformity with the individual services drawings and within the requirements of Architectural, HVAC, Electrical, Structural and Other specialized services drawings.

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 programmed.

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 Engineer-in-Charge. 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

All the 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.

Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

Contractor shall verify all dimensions at site and bring to the notice of the Architects or Engineer-in-Charge all discrepancies or deviations noticed. Architects decision shall be final.

Large size details and manufacturers’ dimensions for materials to be incorporated shall take precedence over small-scale drawings.

All drawings supplied with the Tender shall be returned in good conditions along with the Tender.

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

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.

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

All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-in-Charge.

All Testing Equipment shall be preferably located in special room meant for the purpose.

6 METRIC CONVERSION

All dimensions and sizes of materials and equipment given in the Tender document are commercial metric sizes.

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

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.

All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

8 SHOP DRAWINGS

The Contractor shall submit to the Engineer-in-Charge six copies of the shop drawings.

Shop drawings shall be submitted under following conditions:-

- Contractor shall prepare shop drawings of plumbing / Fire fighting / Medical Gases / Boiler / Sewage treatment plant etc, for the entire hospital within four weeks of the award of work. These drawings shall be submitted to the Engineer-in-Charge for approval and the work shall be executed at site on the basis of these approved drawings.
- Large scale drawings showing typical details for Toilets & Fixtures.
- Equipment layout, piping and wiring diagram.
• Structural supports/hanging/laying and jointing details for all types of pipes as required.
• Layout plans as required and for any changes in the layout of Plumbing / Architectural Drawings.

9 AS BUILT DRAWINGS

The Contractor shall maintain one as built copy of all Drawings, Specifications, Addenda variations, approved submittals, correspondence, and transmittals at the site in good order and readily available to the Owner and the Engineer-in-Charge. The As built Drawings shall be clearly and correctly marked and as built specifications annotated by the Contractor to show all changes made during the construction process at the time the changed Work is installed. No such changes shall be made in the Work unless previously authorized by the change order or by specific approval of deviations or revisions in submittals.

The Contractor shall prepare and furnish to the Architect / services consultant accurate as built drawings. Architect / Services consultant shall approve these drawings after due verification at site. After approval, the contractor shall submit to Engineer-in-Charge, A1 size three (3) black line white paper prints as well as soft copy in form of CD of each drawing as part of close out documents. Project manager shall forward the same to the owner for their records and for maintenance and operation.

The as built drawings must have the following information:

The works as executed complete with:

• Run of all piping & diameters on all floors and vertical stacks.
• Ground and invert levels of all drainage pipes together with location of all manholes and connections up to out fall.
• Run of all water supply lines with diameters, locations, of Control Valves, Access Panels.
• Location of all Mechanical equipment with whole plant layout, piping connections and panels as erected.
• Details of supports left in place and locations of all services encountered.
• Complete schematic diagram of the installation, as installed.
• Complete Schematic flow diagram for Sewage treatment plant.
• Complete layout plan of Sewage treatment Plant.
• Hot water generator room layout and Schematic of the system

10 CONTRACTORS RATES

Rates quoted in this Tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, sales tax on works
contract and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

Rates quoted are for all heights and depths required for this work.

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 Engineer-in-Charge. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

Rates quoted shall be inclusive of cost incurred in testing, commissioning of works and materials.

11 TESTING

Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

Tests shall be performed in the presence of the Engineer-in-Charge / Consultant.

All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

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.

Contractor shall provide all labour, equipment and materials for the performance of the tests.

Contractor shall afford all the expenses for the offsite testing of material and equipments.

12 SITE CLEARANCE AND CLEANUP

The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

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.

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
Contractor must hold a valid Plumbing license issued by the Municipal Authority or other competent authority under whose jurisdiction the work falls.

Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to water supply, sewerage, drainage and 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.

Contractor shall obtain No Objection Certificate before commencement of work, from the local authorities all related to his work as required for the building.

Contractor shall obtain, from the local authorities all related completion certificates with respect to his work as required for occupation of the building.

All inspection fees or submission fees paid by the Contractor shall be reimbursed by the Owner on production of valid official receipts.

14 CUTTING & MAKING GOOD

No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

15 MATERIALS

All materials used in the works shall conform to the Tender specifications.

As far as possible materials bearing I.S. certification marks shall be used with the approval of the Engineer-in-Charge.

Unless otherwise specified and expressly approved in writing by the Engineer-in-charge, materials of makes and specifications mentioned with Tender shall be used.
SECTION – I : SANITARY FIXTURES & FITTINGS

16 SCOPE OF WORK

Work under this section shall consist of furnishing all labor 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.

Without restricting to the generally of the foregoing the Sanitary Fixtures shall include all Sanitary Fixtures, C.P. fittings and Accessories etc. necessary and required for the Building.

Whether specifically mentioned or not all Fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

Testing of all fixture and fittings.

17 GENERAL REQUIREMENTS

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 Drawing, Specifications and Drawings.

All Fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architectural/Interior designer’s requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

Fixing screws shall be half round head Chromium Plated brass with C.P. washers wherever required as per directions of Engineer-in-Charge.

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.

When directed, Contractor shall install Fixtures and accessories in a mock-up room for the approval of the Engineer-in-Charge Sample room Fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.
17.1 Supporting and Fixing Devices

The contractor shall provide all supporting and fixing devices necessary to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly look in the final assembly. Where the location demands, the Architects may instruct the contractor to provide chromium plated or other similarly finished fixing devices. In such circumstances the contractor shall arrange to supply fixing devices and install them complete with appropriate vibration isolating pads, washers and gaskets.

17.2 Final Installation

The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. The connection between building piping system and the sanitary fixtures shall be through proper unions and flanged 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 outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. 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 arranged as to give visible warning and discharge. A check shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, wash basins, sinks and other appliances.

Joints/gaps between all sanitary appliances/fixtures and the floor/walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of color and shade to match that of the appliances/fixture and the floor/wall to the extent possible.

17.3 Protection against Damage

The contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, crazing, staining breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation. At the time of handing over, the contractor shall clean, disinfect and polish all fixtures and fittings. Any fixtures and fittings found damaged, cracked chipped, stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.
18 **EUROPEAN W.C.**

European W.C. shall be wash down, single or double siphonic type, wall mounted set, flushed by means of exposed cistern, as specified in Drawing. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

Each W.C. shall be provided with 110mm dia (OD) PVC connector connecting the ceramic outlet of W.C.

19 **INDIAN W.C.**

Indian W.C. pan shall be Orissa pattern of size as specified in the Drawing. Each W.C. shall be provided with a 100 mm dia cast iron or porcelain P or S trap with or without vent horn.

W.C. shall be flushed by means of an exposed or concealed type flush valve or as specified in Drawing.

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.

19.1 **G.I. Pipes**

Waste pipes may be exposed on wall or concealed in chase as directed by the Engineer-in-Charge. Specifications for waste pipes shall be same as given in Sub Section.

20 **FLUSHING CISTERN**

Flushing cistern shall be concealed or Exposed type design for low volume dual flushes 3 Ltrs & 6 Ltrs as directed by Engineer-in-Charge or mentioned in the drawing.

21 **LAVATORY BASIN**

Lavatory Basins shall be white glazed vitreous china of size, shape and type as indicated in architectural drawings.

Each Basin shall be provided with MS. or C.I. brackets and clips and the basin securely fixed to wall. Placing of Basins over the brackets without proper securing and fixing shall not be accepted.
Each Basin shall be provided with 32mm dia C.P. waste with overflow, pop-up waste or rubber plug and chain, 32mm dia C.P. Brass Bottle Trap with C.P. pipe to wall and flange.

Each basin shall be provided with CP brass push type self closing pillar tap or Single hole Mixing Fitting as mentioned in the drawing.

Basins shall be fixed at proper heights as shown on architecture drawings. If height is not specified, the rim level shall be 79 cms above the floor or as directed by Engineer-in-Charge.

22 SINKS

Sinks shall be of precast Terrazzo marble or White Glazed fire clay or vitreous china or stainless steel or any other material as specified in the architectural drawing.

Hand Wash Sinks and Process Sinks shall be of stainless steel.

Each sink shall be provided with M.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 Engineer-in-Charge.

Fittings for sinks shall be mixing fittings or as specified in the architectural drawing.

23 SHOWER SET

Shower set shall comprise of single lever mixer adjustable hand shower.

Each shower set shall also be provided with Overhead C.P. shower with 100mm long arm with flange of approved quality.

Concealed stop cocks wherever required 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.

24 ACCESSORIES

Accessories shall be of any of the following types:

- Towel rails
  
  Towel rail shall be C.P brass of size 610mm long and 20mm dia, and fixing with C.P brass brackets fixed to wooden cleats with C.P. brass screws.

- Towel rings
Towel rail shall be C.P brass of size 150mm dia, and fixing with C.P brass brackets fixed to wooden cleats with C.P. brass screws.

- Toilet paper holder

Toilet paper holder shall be of Satin finish stainless steel AISI 316 grade wall mounted type fixed to wooden cleats with C.P. brass screws.

- Hand Dryer

Hand dryer shall be of best quality, to be operated with 230 volts, single phase, with fully hygienic condition, with all accessories and fixing in the wall as mention in the Architectural drawing or as directed by Engineer-in-Charge.

- Coat hooks

Coat hooks shall be of satin finish stainless steel AISI 316 grade wall mounted coat hooks fixed to wooden cleats with C.P. brass screws or as directed by Engineer-in-Charge.

- Soap dispensers

Soap dispensers shall be of satin finish stainless steel AISI 316 grade wall mounted liquid soap dispenser with indicator having bottom trough of soap fixed to wooden cleats with C.P. brass screws or as directed by Engineer-in-Charge.

Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good.

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. The flange of the recessed fixture shall cover the recess in the wall fully.

Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by Engineer-in-Charge.

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 Engineer-in-Charge.
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.

25 TESTING AND ACCEPTANCE

Testing is done as per BS-5572 of Make & Model of Sanitary fixture & fittings

SECTION – II  INTERNAL DRAINAGE SOIL, WASTE & VENT PIPES

26 SCOPE OF WORK

Work under this section shall consist of furnishing all labor, 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 as directed by the Engineer-in-Charge.

Without restricting to the generally of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-

- Vertical and horizontal Soil, Waste and Vent Pipes, Rainwater Pipes and Fittings, Joints Clamps and connections to Fixtures.
- Connection of pipes to Gully Traps & Manholes etc.
- Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads as specified.
- Waste pipes connections from all Fixtures e.g. wash basins, sinks, urinals and kitchen equipments.
- Testing of all pipes.

27 GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-Charge.

Soil, waste and vent pipes in shafts, ducts and in concealed areas i.e. (false ceiling) shall consist of uPVC, SWR Pipe.

- Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

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.

Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. Pipes shall as far as possible be kept 50mm clear of wall.
Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

Every waste pipes shall discharge above the grating of properly trapped gully. Contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided it shall be ensured that at-least one washbasin/washing trough is connected to such floor traps to avoid drying of water seal in the trap.

All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75mm or more than 300mm from their highest part and on the side nearest to the soil pipe or waste pipe.

All works shall be executed as directed by Engineer-in-Charge.

27.1 Soil, Waste & Vent Pipes

a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains . Waste stacks have been provided with a “P” trap at basement ceiling.

b) All waste water from AHU's, A.C. plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.

c) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement ceiling or to an external manhole directly wherever feasible as shown on the drawings.

d) All soil and waste from areas below general ground level (Basements) will be collected in sumps and pumped into sewer lines.

e) Anti-siphonage pipe (ASP) shall be provided for soil fittings on vertical stacks. It may also be provided for waste lines where shown on the drawings.

f) Vent pipes shall be provided at all sewer lines at the starting manholes.

g) Waste pipe used in kitchen area shall be Cast Iron Pipes. All pipes shall be straight and smooth and inside free from irregular bore, blowholes, cracks and other manufacturing defects. Pipes shall be centrifugally cast (spun) iron pipes conforming to I.S:3989.

h) Jointing of pipe: All CI Pipe shall be joint with Drip seal PJS – 43. It is a salient manufactured in two colors “Black” and “White”, and can be used for sealing of C.I Pipe joints. The density of Drip Seal PJS – 43 should be 1.95 grams / c.c.

i) Mixing & Application: The Drip seal in two different colors is mixed homogeneously in the supplied packets. In cold conditions both unmixed packets are to be heated in Sun or heated to room temperature (25° C) to make them more workable for mixing. The pipe joint is cleaned to make it free from dust, grease, oil, cement splashes and all other foreign matters and contaminants. The joint is made dry. Hemp yarn is provided as usual in pipe joint as back filler. Force the mixed compound into the lap of pipe joint with Caulking tool, MS Flat
piece or by Hand. Proper pressing of compound is necessary to avoid air entrapment. The joint is not to be disturbed till the compound is hardened. The mixed compound has a life of 30 to 40 minutes and should be used within this consumption period.

<table>
<thead>
<tr>
<th>Diametre of Pipe (mm)</th>
<th>Consumption per joint (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>130 to 150</td>
</tr>
<tr>
<td>80</td>
<td>150 to 170</td>
</tr>
<tr>
<td>100</td>
<td>200 to 250</td>
</tr>
<tr>
<td>150</td>
<td>250 to 300</td>
</tr>
</tbody>
</table>

27.2 Rainwater Pipes

a) All terraces shall be drained by providing down-takes rainwater pipes.

b) A separate piped drainage system for slopping roof with leaders shall be provided.

c) Rainwater pipes are separate and independent connected to the external storm water drainage system as shown on the drawings.

d) Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water drains.

e) Any dry weather flow from waste appliances, AHU's pump rooms, shall be connected to the sewerage system only.

27.3 Balcony/Planter drainage

Open balconies, terraces, planters and formal landscape areas will be drained by a separate pipe connected to external storm water drainage system.

27.4 uPVC pipes for SWR system (for soil waste and rain water)

Pipes

- All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be conforming to I.S. 13952 type B for soil & waste and of type A for rain water.

- Pipes shall be joined by approved type of socket and ‘O’ rubber ring (confirms to I.S. 5382) joints with rubber lubricant.

Fittings

- Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching I.S. Specification. Interchange of
pipes of one standard with fittings on the other standard will not be permitted.

- Fittings shall be of the required degree of curvature with or without access door.
- Connection from a vertical stack or position to a horizontal line shall be made only by a “Y” junction.

Fixing
- All vertical pipes shall be fixed truly vertical to walls with approved type of uPVC saddle clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:
  - Horizontal pipes running along ceiling shall be fixed on galvanized structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.
  - Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Engineer-in-charge for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

Clamps
- Holder bat clamps shall be of standard design and fabricated from galvanized M.S. standard flats 40x3 mm thick and 12 mm dia M.S. Rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1:2:4 mix blocks 10x10x10 cms deep.
- Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with galvanized 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
- For SWR pipes conforming to IS 13592 shall be clamped to wall with approved type of uPVC saddle clamp/ U-clamp or as given in the Bill of quantities.
- Structural clamps shall be fabricated by electro-welding from M.S. structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- Galvanized 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 schedule of quantities. 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.
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- 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 20 mm nominal size) as directed by the Engineer-in-Charge.
- For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

### CLAMP AND PIPE SUPPORT SPACING

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of Pipes &amp; Position</th>
<th>15/20</th>
<th>20/25</th>
<th>32/40</th>
<th>50</th>
<th>75/80</th>
<th>100/110</th>
<th>150/160</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Vertical Pipes</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>1.1</td>
<td>GI/MS Pipes</td>
<td>2.4</td>
<td>2.4</td>
<td>3</td>
<td>3.6</td>
<td>4.5</td>
<td>5.4</td>
<td></td>
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<tr>
<td>1.2</td>
<td>uPVC Pipes</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>SWR Pipes</td>
<td>x</td>
<td>x</td>
<td></td>
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<tr>
<td></td>
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<tr>
<td>1.3</td>
<td>uPVC/cPVC Pipes</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>IS 4985 for Water Supply</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IS 13585 for SWR</td>
<td>x</td>
<td>x</td>
<td>0.5</td>
<td>0.7</td>
<td>0.9</td>
<td>0.9</td>
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<tr>
<td>2</td>
<td>Horizontal Pipes</td>
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<tr>
<td>2.1</td>
<td>GI/MS Pipes</td>
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<tr>
<td></td>
<td>uPVC pipes</td>
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<td></td>
<td>SWR Pipes</td>
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<td>Water Supply Pipes uPVC</td>
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</tr>
<tr>
<td>2.3</td>
<td>Fittings</td>
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</tr>
</tbody>
</table>

#### 27.5 Traps

**27.5.1 Floor traps**

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and main waste pipes in toilets having 150 mm sinking shall run below slab and shall be supported from the ceiling below. The trap and waste pipes in sunken area (where required) 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 mm 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 cms of the required depth.

**27.5.2 Urinal traps**

Urinal traps/horn shall be cast iron P or S traps with or without vent shall be fixed as specified for floor traps.

**27.5.3 Floor trap inlet**
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Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to a uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. uPVC multi-inlet trap can be used where ever possible to be decided by the Engineer-in-Charge.

**Trap & Seals**

All traps shall be self cleaning design and the seal depth shall be as specified below wherever the traps are not integral with the appliances:

<table>
<thead>
<tr>
<th>Appliance or ware</th>
<th>Material</th>
<th>Trap Type</th>
<th>Seal depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatory /wash basin</td>
<td>C.P. cast brass</td>
<td>32 mm dia Bottle</td>
<td>75 mm</td>
</tr>
<tr>
<td>Sink</td>
<td>C.P. cast brass</td>
<td>40 mm dia Bottle</td>
<td>75 mm</td>
</tr>
<tr>
<td>Kitchen floor drain of fabricated drain boxes</td>
<td>uPVC/C.I.</td>
<td>75/100 mm dia ‘P’ or ‘S’</td>
<td>50 mm</td>
</tr>
<tr>
<td>Urinals</td>
<td>uPVC/C.I.</td>
<td>100 mm dia ‘P’ or ‘S’</td>
<td>50 mm</td>
</tr>
<tr>
<td>AHU’s</td>
<td>uPVC/C.I.</td>
<td>75 mm dia ‘P’ or ‘S’</td>
<td>50 mm</td>
</tr>
</tbody>
</table>

27.5.4 Floor Gratings

Floor and urinal traps shall be provided with 100-150mm square or round C.P./ Stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm.

27.5.5 Jointing

Pipe to pipe and pipe to fitting (SWR) joint shall be with ‘O’ rubber ring as recommended by the manufacturer. Jointing with solvent cement shall be applied to uPVC waste pipes (confirming to I.S. 4985) and fittings or as recommended by the manufacturer’s.

27.6 Cleanout Plugs (on soil pipes)

32.6.1 uPVC Clean out pipe for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, “Ys” and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.
32.6.2 Cleanout on Drainage Pipes

Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Engineer-in-Charge. Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 160 mm OD.

Cleanouts at ceiling level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

27.7 Waste pipe from appliances

27.7.1 General

a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of uPVC pipes 40, 50 or 63 mm OD conforming to IS:4985 class II (6 kg/cm²) shown on the drawings.

b) 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 galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section 1.

27.8 Encasing Pipe in Cement Concrete

uPVC soil and waste pipes and drainage under floor 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 all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one meter.

27.9 Testing

Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.

Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.

All materials obtained and used on site must have manufacturer's Hydraulic Test Certificate for each batch of materials used on the site.
27.10 Testing Soil, Waste and Rainwater Pipes

Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. Rectify and replace where required.

Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of Engineer-in-Charge and signed by both.
SECTION – III  EXCAVATION FOR PIPE LINE

28  EXCAVATION

The excavation for pipe works shall be open cutting unless the permission of the Engineer-in-Charge for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Engineer-in-Charge may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be brought back later on for refilling the trenches or tunnel.

28.1 Opening out Trenches

In excavation the trenches, etc. the solid road metal ling, pavement, curbing etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Engineer-in-Charge and of the Owners of the roads or other property traversed and the Contractor shall not cut out or break down any live fence of trees in the line of the proposed works but shall tunnel under them, unless the Engineer-in-Charge shall order to the contrary.

The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Engineer-in-Charge.

28.2 Obstruction of Roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Engineer-in-Charge in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

28.3 Removal of Filth

All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.
28.4 Excavation to be taken to Proper Depths

The trenches shall be excavated to such a depth that the pipes shall rest on concrete or on firm bedding as described in the several clauses relating to these so that the inverts may be at the levels given in the sections. In bad ground, the Engineer-in-Charge may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewers with concrete, broken stone, gravel or other materials. For such extra excavation and concrete, broken stone, gravel or other materials, the Contractor shall be paid extra at rates laid down for such works in the schedule, if the extra work was ordered by the Engineer-in-Charge in writing, but if the Contractor should excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Engineer-in-Charge the extra depth shall have to be filled up with concrete 1:5:10 mix (1 cement: 5 fine sand: 10 stone aggregate 40mm nominal size) at the Contractor’s own costs and charges to the requirements and satisfactions of the Engineer-in-Charge.

28.5 Refilling

After the pipes or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms layers with materials taken from the excavation, each layer being watered to assist in the consolidation unless the Engineer-in-Charge shall otherwise direct.

28.6 Contractor to Restore Settlement and Damages

The Contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expenses and charges, repair and make good and damage done to buildings and other property. If in the opinion of the Engineer-in-Charge he fails to make good such works with all practicable dispatch, the Engineer-in-Charge shall be at liberty to get the work done by the Contractor or deducted from any money that may be or become due to him or recovered from him in any other manner according to the law of the land.

28.7 Disposal of Surplus Soil

The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.
28.8 Timbering of Sewer and Trenches

The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be close, timbered in loose or sandy strata and below the surface of the sub soil water level.

All timbering, sheeting and piling with their waling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

The Contractor shall be held responsible and will be accountable for the sufficiency of all timbering, branches, sheeting and piling used as also for all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

28.9 Shoring of Buildings

The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

28.10 Removal of Water from Sewer, Trench etc.

The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed off by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

28.11 Width and Depth of Trench

The Engineer-in-Charge shall have power by giving an order in writing to the Contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classes of sewer, manholes, and other works in certain lengths to be specifically laid down by him, where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.
SECTION – IV  WATER SUPPLY SYSTEM (COLD & HOT)

29  SCOPE OF WORK

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.

Without restricting to the generality of the foregoing, the water supply system shall include the following:-

a) Municipal water connection including water meter up to U.G. water tanks.
b) Piping from tube well to raw water tank
c) Distribution system from overhead tank to from booster pumps & bygravity as per schematic drawing in the building.
d) Excavation and refilling of pipes trenches.
e) Control valves, masonry chambers and other appurtenances.

• All water lines to different parts of building and making connection from source etc.
• Pipe protection and painting.
• Providing Hot water supply and return lines and insulation of hot water pipe lines.
• Control valves, masonry chambers and other appurtenances.
• Connections to all toilets kitchen equipments, tanks and appliances.
• Excavation and refilling of pipe trenches, wherever necessary.
• Trenches for taking pipe lines for these services if required.

30  GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

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.

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.
Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

As far as possible, all piping inside the buildings shall run either concealed or embedded. Outside the buildings the piping shall be installed at-least 60cms below finished grade. All galvanized steel piping embedded either in trenches or in concrete and masonry work shall be tightly wrapped 1mm thick fiberglass tissue laid in bitumen.

Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

**Water Supply System**

Contractor should study the site plan and water supply system diagram for an overview of the system.

**Source**

a) Water supply will be acquired from Municipal water mains through a service connection

b) Additional water supply will be obtained from captive tube-wells within the site. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank.

Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independently connected to a different pumping system.

### 31 G.I. PIPES & FITTINGS

All pipes outside the building and pipes running at basement ceiling level shall be galvanized steel tubes conforming to IS: 1239-1979 of class specified. When class is not specified they shall be medium class.

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 and Bushes. Fittings shall be of IS:1879 - (part I to X) 1975.

Pipes and fittings shall be jointed with threaded fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. 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.
MEDICAL COLLEGE AND HOSPITAL AT SUNDEGARH

32 CLAMPS

G.I. pipes in shafts and other locations shall be supported by galvanized clamps of design approved by Engineer-in-Charge. Pipe in wall chases shall be anchored by iron hooks. Pipes at ceiling level shall be supported on structural clamps fabricated from galvanized structural as described in the sub-section. Pipes in typical shafts shall be supported on Slotted Angles/Channels as specified elsewhere.

Pipe hangers shall be provided at the following maximum spacing:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Pipe Dia (mm)</th>
<th>Hanger Rod Dia (mm)</th>
<th>Spacing between Supports (Mtr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upto 25</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>32 to 50</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>65 to 100</td>
<td>12</td>
<td>2.4</td>
</tr>
<tr>
<td>4</td>
<td>125 to 150</td>
<td>16</td>
<td>3.6</td>
</tr>
<tr>
<td>5</td>
<td>200 to 300</td>
<td>19</td>
<td>5.3</td>
</tr>
</tbody>
</table>

33 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 Engineer-in-Charge.

34 FLANGES

Flanged connections shall be provided on pipes where shown on the drawings, all equipment connections as necessary and required or as directed by Engineer-in-Charge. 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 Engineer-in-Charge. Bolt hole dia for flanges shall conform to match the specification for C.I. Sluice Valve to I.S. 780.

35 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:

<table>
<thead>
<tr>
<th>Dia of Pipe</th>
<th>Width of Trench</th>
<th>Depth of Trench</th>
</tr>
</thead>
<tbody>
<tr>
<td>15mm to 50mm</td>
<td>30 cms</td>
<td>60 cms</td>
</tr>
<tr>
<td>65mm to 100mm</td>
<td>45 cms</td>
<td>75 cms</td>
</tr>
</tbody>
</table>
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 earth work 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.

36 PAINTING

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 color code specified by Engineer-in-Charge.

All pipes in chases and below floor shall be provided with Anti-corrosive treatment.

37 PIPE PROTECTION

Where specified in the Drawing all pipes below ground shall be protected against corrosion by wrapping 100mm wide and 4mm thick layer of PYPKOTE/MAKPOLYKOTE over the pipe.

37.1 Sand Filling

All G. I. pipes in trenches shall be protected with fine sand 150 mm all around before filling in the trenches.

38 GUNMETAL VALVES

Valves 65mm dia and below shall be heavy Gunmetal Full way Valves or Globe Valves or Ball valves conforming to IS: 778-1971 of 20 Kg/cm2 class. Valves shall be tested at manufacturer’s works and the same stamped on it.

All Valves shall be approved by the Engineer-in-Charge before they are allowed to be used on work.

39 SLUICE VALVES

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. Sluice valves shall be of best quality conforming to IS: 780-1969 of class specified.

- Joints for double flanged sluice valves shall be made with suitable
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.

- Sluice valves shall be installed at all branches and as shown on the drawings.

39.1 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 Engineer-in-Charge.

39.2 Air Release Valves

- Air release valves shall be single acting type air valves with Gunmetal body and bronze/gunmetal internal parts and plastic float.
- Each air release valve shall be provided with a cast iron isolating sluice valve of specification given above.

40 INSULATION

40.1 For Chased Internal Pipes

Hot water pipes fixed in chase shall be thermal insulation over hot water pipes with 9mm thick nitrile or approved equivalent thermal insulation tubing, a elastomeric flexible material having hermetic blister closed cell structure of expanded synthetic rubber having a thermal conductivity not exceeding 0.040w/m°k @ 40deg C over pipes.

40.2 For Exposed Piping

Exposed hot water line laid in trenches, exposed in shafts, on terrace and along ceiling level shall be thermal insulation over hot water pipes with 9mm thick nitrile/ polyolefin or approved equivalent thermal insulation tubing, a electrometric flexible material having hermetic blister closed cell structure of expanded synthetic rubber having a thermal conductivity not exceeding 0.040w/m°k @ 40 deg C over pipes. With Aluminum Cladding/ protective coating of resin hardener paint with fiber cloth (FRP)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Pipe Size (MM)</th>
<th>Thickness of Nitrile Rubber Insulation (MM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15 to 25</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>32 to 80</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>100 &amp; above</td>
<td>19</td>
</tr>
</tbody>
</table>
40.3 Anchor Block

Suitable anchor blocks shall be provided at all bends and tees to encounter the excessive thrust developed due to water hammer.

41 CPVC PIPES

All pipes inside the buildings and where specified, outside the building shall be CPVC pipes tubes conforming to IS 15778:1996. Specific Gravity ASTM D 792 at 23°C should be 1.55 as specified. With Tensile Strength as per ASTM D 638 at 23°C should be 55N/mm².

41.1 Joining Pipe & Fittings

41.1.1 Cutting

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

41.1.2 Deburring / Beveling

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fitting during assembly.

41.1.3 Fitting Preparation

A clean dry rag/cloth should be used to wipe dirt and moisture on the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

41.1.4 Solvent Cement Application

Only CPVC solvent cement conforming to ASTM-F493 should be used for joining pipe with fittings. CPVC schedule 40 & 80 heavy bodied CPVC solvent cement only should be used conforming to ASTM-F493.

41.1.5 Assembly

After applying the solvent cement on both pipe and fitting socket, pipes should be inserting into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approx) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous, remake the joint to avoid potential leaks.
41.1.6 Set & Cure times:

Solvent cement set & cure times shall be strictly adhered to as per the below mentioned table:

Minimum Core prior to pressure testing at 150 PSI

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Ambient Temperature during Core period</th>
<th>Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>½” to 1”</td>
</tr>
<tr>
<td>1</td>
<td>Above 15 deg C</td>
<td>1 Hr</td>
</tr>
<tr>
<td>2</td>
<td>4 – 15 deg C</td>
<td>2 Hrs</td>
</tr>
<tr>
<td>3</td>
<td>Below 4 deg C</td>
<td>4 Hrs</td>
</tr>
</tbody>
</table>

Once an installation is completed and cored as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 PSI (10 Bar) for minimum 24hrs. During pressure testing the system should be filled with water and if a leak is found, the joint should be cut out and replacing the same with new one by using coupler.

41.1.7 Transition of CPVC to Metals

When making a transition connection to metal threads, special brass/plastic transition fitting (Male & Female adopters) should be used. Plastic threaded connection should not be over torque hard tight plugs one half turn should be adequate.

41.1.8 Threaded Sealants

Teflon tapes shall be used to make threaded connection leak proof.

41.1.9 Hangers & Supports

For horizontal runs, support should be given at 3 ft (90 cms) intervals for diameter of 1” and below and at 4 ft (1.20 mtr) intervals for larger size.

Hangers should not have throw or sharp edges which come in contact with the tubing and shall be of GI.

Support should be as per the below mentioned table:

<table>
<thead>
<tr>
<th>S. No</th>
<th>Size of Pipe Inch</th>
<th>210C Ft</th>
<th>490C Ft</th>
<th>710C Ft</th>
<th>820 C Ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>½”</td>
<td>5.5</td>
<td>4.5</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>¾”</td>
<td>5.5</td>
<td>5.0</td>
<td>3.0</td>
<td>2.5</td>
</tr>
<tr>
<td>3</td>
<td>1”</td>
<td>6.0</td>
<td>5.5</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>11/4”</td>
<td>6.5</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>5</td>
<td>11/2”</td>
<td>7.0</td>
<td>6.0</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>6</td>
<td>2”</td>
<td>7.0</td>
<td>6.5</td>
<td>4.0</td>
<td>3.5</td>
</tr>
</tbody>
</table>
All special fittings and accessories like internally or externally threaded brass adaptors, ball valves, globe valves, unions, diaphragm valves, butterfly valves, etc shall be made of CPVC by licensee.

The CPVC solvent cement used for installing CPVC piping systems shall conform to ASTM F493. Pipes from ½” up to 2” pipes and fittings, single step medium bodied CPVC solvent cement should be used. For CPVC pipes and fittings upwards of 2”, a primer shall be used followed by heavy bodied solvent cement conforming to ASTM F493. PVC solvent cement should not be used.

41.2 Concealed Plumbing

All internal concealed plumbing for water supply shall be done with CPVC pipes. The pipes & fittings shall conform to CTS (Copper Tube Size) SDR-11 as per ASTM D2846. All pipes and fittings from ½” up to 2” shall come under this category. Medium body CPVC solvent cement conforming to ASTM F493 should be used for joining pipes to fittings.

41.3 Installation procedure

All parameters pertaining to the installation of CPVC plumbing system such as cutting, joining, support spacing, expansion loops, insulation, type of support, special connections, etc. shall be as per the manufacturer’s specifications.

42 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 with cast iron surface box as approved or as specified in Drawing and in drawings including excavation, back filling complete.

43 WATER METERS

Water meters of approved make and design shall be supplied for installation at locations as shown in drawing. The water meters shall meet with the approval of the local municipal authorities. Suitable valves and chambers to house the meters shall also be provided along-with the meters.

All meters shall conform to Indian Standard IS: 779-1978 (Water meters-domestic type) and IS: 2373-1981 (water meters-bulk type). Where called for water meters shall be located in masonry chambers of appropriated size.
Technical Specifications for Plumbing, Fire Fighting & Medical Gas System (MGS) Works

44 PIPE HANGERS BRACKETS ETC.

Sturdy hangers, brackets and saddles of approved design shall be installed to support all pipe lengths which are not embedded over their entire run. The hangers and brackets shall be of adjustable heights and primer coated with red-oxide primer clamps. Collars and saddles to hold pipes shall be provided with suitable gaskets. The brackets and hangers shall be of Mild Steel designed to carry the weight of pipes safely and without excessive deflections.

All pipes and fittings shall be supported near every joint and half-way through every pipe length unless otherwise specified. Where called for, pipe hangers shall also be supplied with proper sound and vibration dampening devices to minimize noise and vibration transmission.

45 TESTING

All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times, the working pressure and subject to minimum of 7 kg/cm² in any case and with the consent of Engineer-in-Charge.

Pressure shall be maintained for a period of at least TWELVE hours without appreciable drop in the pressure after fixing at site. (+10 %). A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Engineer.

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.

After completion of the water supply system, Plumbing 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.

46 CONNECTIONS TO WATER TANKS

The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflow, control valves and all such other piping connections including level indicator to water storage tanks as called for.

Suitable float controls of an approved make, securely fixed to the tank independent of the inlet pipe and set in a position so that water inlet into the tank is cut off when filled up to the water line. The water level in the tanks shall be adjusted to 25mm below the lip of the overflow pipe. Full way
gate/ball valves of approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe.

The overflow pipe shall be so placed as to allow the discharge of water being readily seen. The overflow pipe shall be of size indicated. A stop valve shall also be provided on the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning. The ball valves shall conform to Indian Standard IS:1703-1968

47 CONNECTIONS TO MECHANICAL EQUIPMENT SUPPLIED BY OTHER AGENCIES

All inlets, outlets, valves, piping and other incidental work connected with installation of all mechanical equipment supplied by other agencies shall be carried out by the Plumbing contractor in accordance with the drawings, requirements for proper performance of equipment, manufacturer’s instructions and the directions of the Engineer-in-Charge. The equipment to be supplied by other agencies consists mainly of Kitchen, Laundry, Air-conditioning, Water Treatment and other similar equipment. The connections to the various equipment shall be effected through proper unions and isolating valves. The work of effecting connections shall be executed in consultation with and according to the requirements of equipment suppliers, under the directions of the Engineer-in-Charge. The various aspects of connection work shall be executed in a manner similar to the work of respective trades mentioned elsewhere in these specifications.

48 DISINFECTION

After completion of the work Contractor shall flush clean the entire system with the city’s filtered water after connection has been made.

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. The Commissioning would not be considered complete without performing the Disinfection.

49 PRE COMMISSIONING:

Ensure that all pipes are free from debris and obstructions.

Check all valves and fire hydrant for effective opening and closing action. Defects should be rectified or valves replaced.

Ensure that all Connections to Branches has been made.

Ensure that mains have been connected to the respective pumps, underground and Overhead tanks.
Water supply should be available at main Underground tank.
All main line Valves should be closed.

50 COMMISSIONING

Fill Underground tank with water. Add 1kg fresh bleaching powder after making a solution to be added near inlet.

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.

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).

Fill Overhead tank to full.

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.

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.

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.

The entire water supply system should be disinfected with bleaching powder and system flush cleaned.

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).

51 RESPONSIBILITY

Responsibility for various activities in pre-commissioning and commissioning procedures will rest with the Contractor.
MEDICAL COLLEGE AND HOSPITAL AT SUNDERGARH

SECTION –V: SEWERAGE/DRAINAGE SYSTEM

52 SCOPE OF WORK

Work under this section shall consist of furnishing all Labor, Materials, Equipments and Appliances necessary and required to completely finish Sewerage/Drainage system as specified hereinafter or given in the Drawing.

Without restricting to the generality of the foregoing, the sewerage system shall include:

- Internal sewer line upto first manhole.
- Excavations including refilling etc.
- Construction of Collection Chambers, Manholes and Drop Connections.
- Construction of Grease Trap etc.
- Connection to S.T.P and Disposal of treated effluent.
- Storm Water Drainage and Disposal.
- Construction of Desalting chamber & Rain water Harvesting tank
- Testing of pipe lines

53 GENERAL REQUIREMENTS

All materials shall be new of the best quality conforming to specifications and subject to the approval of the Engineer-in-Charge.

Drainage lines shall be laid to the required gradients and profiles.

All piping shall be installed at depth greater than 80cms below finished ground level.

The piping system shall be vented suitably at the starting point of all branch drains, main drains, and the highest/lowest point of drain and at intervals as shown. All venting arrangement shall be un-obstructive and concealed.

All drainage work shall be done in accordance with the local Municipal byelaws.

Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Engineer-in-Charge.

Location of all manholes, catch basins etc., shall be got confirmed by the Contractor from the Engineer-in-Charge before the actual execution of work at site.

All works shall be executed as directed by Engineer-in-Charge.
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 Engineer-in-Charge 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 Engineer-in-Charge.

SALT GLAZED STONEWARE PIPES

Stoneware pipes shall be of first class quality salt glazed and free from rough texture inside or outside and straight. All pipes shall have the manufacturers name marked on it and shall comply to IS: 651-1971 and shall be of approved makes.

The maximum permissible slope to the various diameters of pipes shall be as follows:

- 100mm pipe ...... 1 in 40 to 1:50
- 150mm pipe ...... 1 in 60 to 1:100
- 200mm pipe ...... 1 in 80 1: 120 to 1: 200
- 250mm pipe ...... 1 in 90 1: 120 to 1: 250

Where necessary, pipe shall be laid on a bed of plain cement concrete 1:3:6 and minimum 150 mm thick, and shall be projected by providing hunching up to half the diameter of the pipes. The width of the concrete bed for various diameters shall be as follows:

- 100mm dia pipe ...... 380mm wide
- 150mm dia pipe ...... 450mm wide
- 200mm dia pipe ...... 600mm wide
- 250mm dia pipe ...... 700mm wide

Where the pipes are laid on a soft soil, with the maximum water table level, lying at the invert level of the pipe, the pipe shall be bedded in concrete.

Laying and Jointing of Stoneware Salt Glazed Pipes

Laying of Pipes

Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before dispatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.
The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor’s cost and charges.

If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

55.1.2 Jointing of Pipes

Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.

After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or “Badger”. The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Engineer-in-Charge. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

- Gully Traps

Gully traps shall be of the same quality as described for stoneware pipes in Clause 5.

Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40mm nominal size) and a brick masonry chamber 30x30 cms inside in cement mortar 1:3 with 10 x 10 cms grating inside and 30x30 cms C.I. sealed cover and frame weighting not less than 7.2 kg to be constructed as per standard drawing. Where
necessary, sealed cover shall be replaced with C.I. grating of the same size.

- Grease Trap

Grease Trap shall be provided on Kitchen waste lines before discharging the waste into the main sewer line. Grease Trap shall be built in brick masonry and shall be similar in construction to manholes. The grease trap shall be constructed to size as shown at the location on drawings. The grease trap shall be provided with drop inlet, drop outlet, galvanized wrought iron sediment pan and a baffle wall. Grease trap shall be provided with 2 Nos, double seal manhole cover and frame which shall be identified with lettering "Grease trap" as per the drawing.

  o Testing of Grease Trap

All rights of the sewer and drain shall be carefully tested for water tightness by mains of water pressure maintained for not less than 30 minutes. Testing shall be carried out for manhole to manhole. All pipes shall be subject to a test pressure of 1.5 meter head of Water. The test pressure will however, not exceed 6mtr head at any point. The pipes shall be plugged preferably with standard design plugs or with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.

56 REINFORCED CEMENT CONCRETEPIPES

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.

56.1 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 then 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 Engineer-in-Charge.
56.1.1 Encasing (all pipes have to be encased)

The sewer pipes shall be completely encased or surrounded with concrete where:

• The maximum water table level is likely to rise above the top of the barrel.
• The top (overt) of pipe is less than 200 cms under the road surface.

56.2 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 semi flexible type collar joint.

56.2.1 Curing

The joint shall be cured for at least 7 days. Refilling at joints will be permitted only on satisfactory completion of curing period.

57 CEMENT CONCRETE AND MASONRY WORKS FOR MANHOLES AND CHAMBERS ETC.

57.1 Materials

57.1.1 Water

Water used for all the construction purposes shall be clear and free from Oil, Acid, Alkali, Organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered well enough for construction purpose.

57.1.2 Aggregate for Concrete

The aggregate for concrete shall be in accordance with I S: 383 and I S: 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Engineer-in-Charge. The size of the coarse aggregate shall be done as per I S: 383.

57.1.3 Sand

Sand for various constructional purposes shall comply in all respects with I S: 650 and I S: 2116. It shall be clean, coarse hard and strong, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt,
loam and other impurities which may be considered by the Engineer-in-Charge as harmful for the construction.

57.1.4 Cement

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I S: 269.

57.1.5 Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I S: 432 (Grade I).

57.1.6 Bricks

Bricks shall have uniform color, thoroughly burnt but not over burnt, shall have plan rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Engineer-in-Charge.

57.1.7 Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the I S code. All such materials shall be approved by the Engineer-in-Charge before use.

57.2 Cement Concrete (Plain or Reinforced)

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 Engineer-in-Charge. Rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.

All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bass at all times. All pipe trenches and foundations shall be kept dry during the curing period.

57.3 Masonry Work

Masonry work for manholes, chambers, brick masonry pipe trench and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Drawing in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

57.4 Cement Concrete for Pipe Support
MEDICAL COLLEGE AND HOSPITAL AT SUNDERGARH

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 Drawing. Type of the bedding is as described as follows:

Unless otherwise directed by the Engineer-in-Charge cement concrete for bed, all round or in haunches shall be laid as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Upto 3 M depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipes in open ground (No sub soil water)</td>
<td>All round (1:4:8)</td>
</tr>
<tr>
<td>Pipes (all) in sub soil water condition</td>
<td>All round (1:4:8)</td>
</tr>
<tr>
<td>Pipes under the building or at road crossing or under public places</td>
<td>All round (1:3:6)</td>
</tr>
</tbody>
</table>

(1=1 cement, 3.5=coarse sand, 6-10 stone aggregate 40mm nominal size)

R.C.C. pipes or C.I. pipes may be supported on brick masonry or precast R.C.C or Cast insitu cradles. Cradles shall be as shown on the drawings.

Pipes in loose soil or above ground shall be supported on brick or RCC anchor blocks as shown on the drawings.

58 MANHOLES AND CHAMBERS

All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:5 (1 cement: 5 coarse sand) or as specified in the Drawing.

All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix or shown on the drawings.

Where not specified, Manholes will be constructed as follows:

<table>
<thead>
<tr>
<th>Size of Manhole Type</th>
<th>90x80 Rect.</th>
<th>120x90 Rect.</th>
<th>910 dia Circular</th>
<th>1220 dia Circular</th>
<th>1520 dia Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum depth</td>
<td>100</td>
<td>245</td>
<td>170</td>
<td>230</td>
<td>Any depth beyond 230</td>
</tr>
<tr>
<td>Average thickness of R.C.C slab</td>
<td>15</td>
<td>15</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Size of cover and frame (Internal dia)</td>
<td>61x45.5</td>
<td>50 dia</td>
<td>56 dia</td>
<td>56 dia</td>
<td>56 dia</td>
</tr>
<tr>
<td>Weight of cover and frame</td>
<td>38 Kg.</td>
<td>116 Kg.</td>
<td>116 Kg.</td>
<td>116 Kg.</td>
<td>116 Kg.</td>
</tr>
<tr>
<td>Type of Cover &amp; Frame</td>
<td>SFRC</td>
<td>SFRC</td>
<td>SFRC</td>
<td>SFRC</td>
<td>SFRC</td>
</tr>
</tbody>
</table>

All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). The benching shall have a slope of 10cm towards the channel. The depth of the channel...
shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

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.

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.

All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab or SFRC precast concrete covers as per instructions of the Engineer-in-Charge. Weight of cover, frame and thickness of slab as given above.

All Rainwater Collection Chamber shall be of the size 50x45x60cm (internal) with horizontal C.I. grating or SFRC precast Gully Grating as per instructions of Engineer-in-Charge. The grating along with frame shall be of size 500x450mm grating having total Wt. of app. 38 Kg and of approved design and quality as per instruction of Engineer-in-Charge. The remaining details of construction shall be same as stated above for the construction of the Manholes etc.

59  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.

60  COMMISSIONING

After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary piping’s, labors, 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, wherever and as may be required. Generally, the following test/inspection has to be carried out:-

- For any Leakages/seepages in the external sewerage and drainage pipes.
- 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.
- 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 – VI: HANDING OVER PROCEDURE

61 DOCUMENTS SUBMISSION

The Contractor shall before finally handing over the completed work in his scope to the Owner, submit the documents as per the Contract and as directed by the Engineer-in-Charge. Given below the checklist for the reference of the Engineer-in-Charge.

<table>
<thead>
<tr>
<th>Packages/ Sanitary</th>
<th>Soil, waste &amp; vent</th>
<th>Water supply</th>
<th>Sewerage/ drainage</th>
<th>Water tanks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finals cleaning</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>List of inventory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training Conducted on</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation Manual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maint. Manual</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>As built P&amp;I Diag/SLD</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Defects Liability</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period/ Warranty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commissioning report</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test reports/ Certificates</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>List of essential spares</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address/ Contact nos. of Vendors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remarks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

62 LIST OF APPROVED MAKES

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Material</th>
<th>IS No.</th>
<th>Brand Name</th>
<th>Manufacturer Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sanitary Wares</td>
<td>771</td>
<td>Hindware/Parryware/Roca</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>C.P. Fittings</td>
<td></td>
<td>Jaquar/Aquaplus/Roca</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>uPVC Pipes &amp; Fittings</td>
<td>4985</td>
<td>SUPREME</td>
<td>Supreme Industries Ltd.</td>
</tr>
<tr>
<td>4</td>
<td>GI &amp; MS Pipes</td>
<td></td>
<td>AKG</td>
<td>AKG Extrusions Pvt Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>KISAN</td>
<td>Kisan Mouldings Limited</td>
</tr>
<tr>
<td>S. No.</td>
<td>Material</td>
<td>IS No.</td>
<td>Brand Name</td>
<td>Manufacturer Address</td>
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<tr>
<td>-------</td>
<td>----------------------------------</td>
<td>--------</td>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1</td>
<td>CPVC Pipes and Fittings.</td>
<td>1239/3589</td>
<td>PRAKASH SURYA</td>
<td>Surya Roshni Limited</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>JINDAL HISSAR</td>
<td>Jindal Tubes Ltd, Hisar</td>
</tr>
<tr>
<td>7</td>
<td>CPVC Pipes and Fittings.</td>
<td>1879</td>
<td>AjayFlow Guard</td>
<td>Ajay Industrial Corporation</td>
</tr>
<tr>
<td>8</td>
<td>GI Fittings (Malleable)</td>
<td>1879</td>
<td>Ashirvad</td>
<td>Ashirvad Pipes Pvt Ltd.</td>
</tr>
<tr>
<td>9</td>
<td>Ball Valves (upto 50 mm dia)</td>
<td>ISO 9002</td>
<td>Astral</td>
<td>Astral Poly technick Limited</td>
</tr>
<tr>
<td>10</td>
<td>Cast Iron Valves (&gt; 65 mm dia)</td>
<td></td>
<td>ZOLOTO</td>
<td>Zoloto Industries, Zoloto House Kapurthala Road, Jalandhar, 144 002</td>
</tr>
<tr>
<td>11</td>
<td>Cast Iron Butterfly &amp; Slim Type (Wafer) Non-</td>
<td>780</td>
<td>Audco</td>
<td>Rajesh Malleable Ltd., 4, GIDC Estate, Phase 1, Vatva, Ahmedabad</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intervale</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Shenco</td>
<td></td>
</tr>
</tbody>
</table>

Technical Specifications for Plumbing, Fire Fighting & Medical Gas System (MGS) Works
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Material</th>
<th>IS No.</th>
<th>Brand Name</th>
<th>Manufacturer Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>Return Valves</td>
<td></td>
<td>Audco</td>
<td>144004</td>
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<tr>
<td>50 mm dia and above</td>
<td></td>
<td>13095</td>
<td>Intervalve</td>
<td>Shenco</td>
</tr>
<tr>
<td>12</td>
<td>Gunmetal /Brass Valves</td>
<td></td>
<td>Audco</td>
<td>Shenco</td>
</tr>
<tr>
<td>13</td>
<td>Ferrules, Balcocks</td>
<td>LEADER</td>
<td>Leader</td>
<td>Project Equipment. Hauz Quazi.</td>
</tr>
<tr>
<td>13</td>
<td>Pressure Regulating Valves</td>
<td>OR</td>
<td>CIM</td>
<td>Project Equipment. Hauz Quazi.</td>
</tr>
<tr>
<td>14</td>
<td>Hot Water Insulation</td>
<td>THERMA FLEX</td>
<td>Thermaflex pipes &amp; insulation Pvt Ltd.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Polybond Organics (P) Ltd. 4-5,4th floor, Narang Chambers, 99/3, NR Road, Bangalore , 560 002</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Garden Irrigation System</td>
<td>PREMIER</td>
<td>Premier Irrigation,C-4, Commercial Centre, Safdarjung Dev. Area, N.D.</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Jain Irrigation Systems Ltd. Jain Fields, Bambhori ,PO 72, Jagaon 425 001</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Pipe Protection anti corrosive tape/treatment</td>
<td>PYPCOTE</td>
<td>IWL Ltd., 508,</td>
<td></td>
</tr>
<tr>
<td>S. No.</td>
<td>Material</td>
<td>IS No.</td>
<td>Brand Name</td>
<td>Manufacturer Address</td>
</tr>
<tr>
<td>-------</td>
<td>---------------------------------------</td>
<td>--------</td>
<td>------------</td>
<td>--------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Jyoti Shikhar, 8 Distt.Centre , Janak Puri, New Delhi</td>
</tr>
<tr>
<td>17</td>
<td>Stoneware Pipes &amp; Gully Traps</td>
<td>651</td>
<td>PERFECT</td>
<td>Hind Protective Coating Ltd. Mumbai</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pragati Concrete Udyog, A-1/B-6, Local Shopping Centre, Janakpuri N.D.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lal Chand Anand &amp; Sons, 13/1, Bulandshahr Rd. Industrial Area, Ghaziabad 200 001</td>
</tr>
<tr>
<td>18</td>
<td>RCC Pipes</td>
<td>458</td>
<td>PRAGATI</td>
<td>Pragati Concrete Udyog, A-1/B-6, Local Shopping Centre, Janakpuri New Delhi</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Jain Spun Pipe Co. New Delhi</td>
</tr>
<tr>
<td>19</td>
<td>SFRC Manholes, Covers &amp; Gratings</td>
<td>12592</td>
<td>KK</td>
<td>KK Manholes &amp; Gratings, 12/16, Sarvapriya Vihar, Basement, New Delhi 110 016</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Goojar Mal Ganpat Rai. 3371, Hauz Qazi, Delhi-10006</td>
</tr>
<tr>
<td>21</td>
<td>Rain Water Hopper Fitting</td>
<td></td>
<td>GMGR</td>
<td>Acutech Mfg Co. Pvt. Ltd</td>
</tr>
<tr>
<td>22</td>
<td>Galvanized iron pipe support</td>
<td></td>
<td>NEER</td>
<td>Acutech Mfg Co. Pvt. Ltd</td>
</tr>
</tbody>
</table>
SECTION – VII: REVERSE OSMOSIS SYSTEM

63 SCOPe & EXTENT OF WORK

63.1 Scope of Work

Work under this contract shall consist of furnishing all labor, materials, equipment and appliances necessary and required to supply, install, commission and operate a Localized RO with water cooler, as per BOQ.

63.1.1 RO Inlet water quality

Design and system manufacturing /assembling is entirely based on the following feed water analysis, assumed for design purpose. Please

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Raw water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td>Absent</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>≤ 2 mg/l</td>
</tr>
<tr>
<td>Turbidity</td>
<td>≤ 2 NTU</td>
</tr>
<tr>
<td>pH</td>
<td>6-8</td>
</tr>
<tr>
<td>Total hardness</td>
<td>≤ 500 mg/l</td>
</tr>
<tr>
<td>Alkalinity</td>
<td>≤ 47 mg/l</td>
</tr>
<tr>
<td>Fluoride</td>
<td>≤ 1 mg/l</td>
</tr>
<tr>
<td>Silica</td>
<td>≤ 10 mg/l</td>
</tr>
<tr>
<td>Iron &amp; Heavy Metals</td>
<td>≤ 1 mg/l</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>≤ 1000 mg/l</td>
</tr>
</tbody>
</table>

63.2 Schedule and Technical Details of Reverse Osmosis System Micron Filter

63.2.1 Purpose

To remove the fine sand particle up to 0.05 micron and reduce silt density index to acceptable level.
63.2.2 Specifications

- Cartridge filter & Housing
  
  Make: Big blue or Kemflo, India /eoq  
  MOC of housing: PP  
  Length: 20"  
  Diameter: 6"  
  Quantity: 1 No.

- Cartridge:
  
  Make: Kemflow/Ametek, USA  
  Cartridge MOC: Polypropylene  
  Length: 20"  
  Diameter: 4"  
  Quantity: 1 No  
  Micron rating: 05micron

63.3 Dosing System

63.3.1 Purpose

To dose antiscalant chemical to protect the scaling formation on RO membranes.

63.3.2 Specifications:

- Chemical Tank Volume: ltr/hr 100
- Max. Frequency Stock per Min.: 100
- Max. Back Pressure: l/h 1.08
- Max. Back Pressure: @ Bar 12.0
- Nominal Back Pressure: l/h 1.38
- Nominal Back Pressure: @ Bar 6.0
- O.D. x I. D.: mm 6 x 4
- Nominal Power: Watts 11
- MOC: PP
- Capacity: 0-6 lph
- Qty: 1 No

63.4 High Pressure Pump

63.4.1 Purpose

To feed the reserve Osmosis Membrane at pressure more than the osmotic pressure Taking consideration flux rate, flow & recovery.
63.4.2 Specifications

<table>
<thead>
<tr>
<th>MOC</th>
<th>STAINLESS STEEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>VERTICAL MULTISTAGE</td>
</tr>
<tr>
<td>FLOW RATE</td>
<td>5000 LITERS PER HOUR</td>
</tr>
<tr>
<td>HEAD</td>
<td>150</td>
</tr>
<tr>
<td>POWER REQUIRED</td>
<td>1.2.KW</td>
</tr>
<tr>
<td>ELECTRICAL</td>
<td>220VSINGLE, 50 HZ</td>
</tr>
<tr>
<td>CYCLE</td>
<td>2900RPM</td>
</tr>
<tr>
<td>MAKE</td>
<td>GRUNDFOS / CRI/ROOSH /EQV.</td>
</tr>
</tbody>
</table>

63.5 RO Membrane

63.5.1 Purpose

To remove the major part of TDS up to 98% by Reverse Osmosis Membranes arranged & designed to give adequate flow & recovery

63.5.2 Specification

<table>
<thead>
<tr>
<th>Type</th>
<th>Spiral Wounded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of Membrane</td>
<td>8.0 inch.</td>
</tr>
<tr>
<td>Length of Membrane</td>
<td>1MT.</td>
</tr>
<tr>
<td>No of Membranes</td>
<td>4</td>
</tr>
<tr>
<td>Recovery per Membrane</td>
<td>10-15 %</td>
</tr>
<tr>
<td>Salt Rejection per Membrane</td>
<td>98-99 %</td>
</tr>
<tr>
<td>Make of Membranes</td>
<td>Dow(Filmtec)/ smonic,USA/ROOSH Systems</td>
</tr>
<tr>
<td>Recovery</td>
<td>60%</td>
</tr>
</tbody>
</table>

63.6 RO Pressure Tube

63.6.1 Purpose

To pack Reverse Osmosis Membranes & operate at High pressure unto 250psi

63.6.2 Specifications

<table>
<thead>
<tr>
<th>MOC</th>
<th>SS/ FRP Composite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diameter of Pressure vessel</td>
<td>8.5 inch</td>
</tr>
<tr>
<td>Length of pressure vessel</td>
<td>2.5miter</td>
</tr>
<tr>
<td>No Pressure Vessels</td>
<td>2</td>
</tr>
<tr>
<td>No of Membrane per Vessel</td>
<td>2</td>
</tr>
<tr>
<td>Position</td>
<td>Horizontal ,Series</td>
</tr>
</tbody>
</table>
63.7 RO Cleaning System

Purpose

We provide a flashing system, which shall help to clean the Membrane & get deposited on the membranes.

<table>
<thead>
<tr>
<th>Flushing Time</th>
<th>15 Minutes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flushing Media</td>
<td>Treated water/Chemical</td>
</tr>
<tr>
<td>Flushing Tank Size</td>
<td>100 litre</td>
</tr>
<tr>
<td>Tank MOC</td>
<td>HDPE</td>
</tr>
<tr>
<td>Flushing Pump</td>
<td>Raw water pump will used</td>
</tr>
<tr>
<td></td>
<td>Semi automatic with two ball valves operation.</td>
</tr>
</tbody>
</table>

63.8 Electrical Panel

63.8.1 Purpose

A control is provided as a safety measure for the Pump & other electrical items.

63.8.2 Specification

- Complete Starters Overload relays & single phase Preventer for pump.
- Voltmeter, Ammeter, MCB’s indicating lights.
- Push buttons. Rocker Switches for Dozers

63.9 Instrumentation

63.9.1 Purpose

Flow Meter : To measure the online flow of water
TDS Meter : To measure the online TDS of water
Low pressure Switch : To protect Ro pump from dry running.
High Pressure Switch : To protect RO pump from back pressure.
Pressure Gauges : For calculate the pressure for each unit in RO system.
Rota Meter : Quantity: 2 Nos.(permeate & reject line)
Range : 2.4cum per hour
Make : Flowstar ,India/Vats,India

63.9.2 Digital TDS Meter

<table>
<thead>
<tr>
<th>Quantity</th>
<th>1 No (Off line)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>10,000 ppm</td>
</tr>
<tr>
<td>Pressure Switch :</td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>2 No (Low &amp; high)</td>
</tr>
<tr>
<td>Range</td>
<td>0-450psi</td>
</tr>
</tbody>
</table>
Make : Indfos, India

**Pressure Gauges**
- Quantity : 6 No
- Range : 0-7 Bar.
- Dial Size : 2 inches
- Type : Bourdon
- Make : Gulck

**63.9.3 Plumbing & Fittings**

Valves, pipelines before Ro module is in upvc (16 bar tested) & CPVC after HPP, till the permeate line termination point.
NRV’S pressure relief valves, wherever needed the system will be on common MS base frame.

**63.10 List of Approved Makes**

1. Acid dosers / pH correction : TuSchon, Germany
2. Micron Filters Housing Cartridges : Filtonte/Ametek, USA
3. High pressure pump : Grundfoss, Denmark
4. R.O Membranes : Hydranautics, USA
5. R.O Pressure tanks : Codeline, USA
6. Electrical Panel : Tricolite Sprint
7. Electrical Switchgear : Siemens L & T GE
8. Meters : Aster, India
SECTION – VIII: FIRE FIGHTING SYSTEM

64 TECHNICAL SPECIFICATION

Work under this sub-head consists of furnishing all Labor, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the

Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the followings:

- Providing M.S. black steel (Class C) pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Painting of pipe and Making Connection to supply system.
- Black Steel Pipe, Mains Laterals, Branches, Valves, Hangers and Appurtenances.
- Portable Fire Extinguishers
- Fire Fighting Pumps, diesel operated pumps, panels and all connected accessories including suction & delivery pipes.
- Testing Commissioning and giving live demonstrations to the various Inspection Authorities and Obtain their "No Objection Certificate" (NOC) for occupation of the building.

65 GENERAL REQUIREMENTS

All materials shall be of the best quality conforming to the Specifications and subject to the approval of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in shaft, passage etc.

Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.

Valves and other appurtenance shall be so located that they are easily accessible for operation, repairs and maintenance.

66 PIPES

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:
MEDICAL COLLEGE AND HOSPITAL AT SUNDERGARH

- Pipes 150 mm dia and below IS: 1239 (Class C) Heavy Class
- Pipe 200 mm dia and above IS 3589 of thickness specified.

67 PIPE FITTINGS

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality.

Fabricated fittings shall not be permitted for pipe diameters 50 mm and below.

When used, they shall be fabricated, welded and inspected in workshops under supervision of Engineer-in-Charge whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

68 JOINTING

68.1 Screwed (50 mm dia pipes and below)

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 MS forged fittings)

68.2 Welding (65 mm dia and above)

Joints between MS 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 rectifier of required current and capacity. The vendor for welding will be approved by Engineer-in-Charge.

68.3 Flanges

Flanged joints shall be provided on:

- Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of with 3 mm insertion neoprene gasket complete.
68.4 Unions

Provide Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

69 PIPE PROTECTION

All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.

All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.

70 PIPE SUPPORTS

All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.

Where inserts are not provided, the 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.

71 TESTING

All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 kg/cm2 without drop in the pressure for at least 2 hours.

Rectify all leakages, make adjustment and retest as required.

72 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).
73  VALVES

73.1 Valves, Gauge and Orifice Plates

Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves up to 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 kg/cm² class-II as per I.S: 778-1971. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.

Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

74  EXTERNAL YARD HYDRANTS

The Contractor shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications and as shown in drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S of size 76.8 x 61.44 x 25.80 cm, as approved by the Architect to equip 2 nos. of 63 mm dia controlled percolating hose and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the Engineer-in-Charge / Architect.

75  INTERNAL HYDRANTS


A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.

The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

76  FIRST-AID HOSE REEL EQUIPMENT

First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall confirm to IS:1532-1969.

The hose tubing shall be 20 mm dia and 36.5m long. The GM nozzle 5mm and globe valve shall be of 20 mm size.
The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the MS pipe riser taken independently from ring.

77 HOSEPIPES, BRANCHPIPES AND NOZZLES

77.1 HosePipes

Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall confirm to type A (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

78 BRANCH PIPE

78.1 BranchPipes

Branch pipe shall be of Gunmetal 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

78.2 Nozzle

The nozzle shall be of Gunmetal 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

79 HOSE CABINET

The internal hose cabinet shall accommodate the Hose pipes, branch pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge MS/aluminum sheet. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per
Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

The hose cabinet shall be painted red and stove enamelled and woods FIRE written in front glazed portion.

80 FIRE BRIGADE INLET CONNECTIONS

Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified, for the following purposes:

- Fire Brigade suction connection for fire static tank with provision of foot valve.
- Fire brigade inlet connection to fire static tank.
- Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of Sluice valve and Non return valve.

The locations of this Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

81 VALVE CHAMBERS

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.

Valve chambers shall be of following size:

- For depths 100 cm and beyond 90x90x100 cm

82 PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per the drawing and shall confirm to IS:2190-1979.

- Two 9 lit. water CO2 type for every 600 m2 area with minimum of 1 extinguisher per floor as per IS:15683
- Dry Chemical powder type of 6 Kg. Capacity as per IS:15683
- CO2 type of 4.5 kg capacity as per IS:15683.

83 SHOP DRAWINGS & SPECIFICATIONS

The Contractor shall submit to the Consultant two copies of Shop Drawings for Fire Fighting works as an Advance Copy to the Engineer-in-Charge 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 Engineer-in-Charge. Also the Contractor shall submit four copies of the Technical Specifications and Catalogues.

Shop drawings shall be submitted for the following conditions:

- Structural supports/hanging/laying and jointing details for all types of pipes as required.
- Fire Fighting layout plans as required and for any changes in the layout of Fire Fighting/Architectural drawings.

The Contractor can only commence the work after the approval of above documents by Consultant.
### LIST OF APPROVED MAKES OF MATERIALS FOR FIRE FIGHTING WORKS

<table>
<thead>
<tr>
<th>S. No</th>
<th>Materials</th>
<th>IS</th>
<th>Brand</th>
<th>Manufacturer / Approved Dealer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MS Pipes</td>
<td>1239/3589</td>
<td>SURYA</td>
<td>Surya prakash</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JINDAL</td>
<td>Jindal Tube Co.</td>
</tr>
<tr>
<td>2(a)</td>
<td>Forged Steel Fittings</td>
<td></td>
<td>V.S.</td>
<td>True Forge/DRP-M</td>
</tr>
<tr>
<td>(b)</td>
<td>Butt Welded Fittings</td>
<td></td>
<td>VICTAULIC</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gunmetal Ball Valves</td>
<td></td>
<td>Leader</td>
<td>Leader Engg. Works, Jullandur</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AUDCO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TBS</td>
<td>Thakur Bhai &amp; Son</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CIM</td>
<td>Project Equipment</td>
</tr>
<tr>
<td>4</td>
<td>C.I. Double flanged sluice valves &amp; check valves</td>
<td>780</td>
<td>Kirloskar</td>
<td>Kirloskar Bros. Ltd., Pune</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Leader</td>
<td>Leader Engg. Works, Jullandur</td>
</tr>
<tr>
<td>5</td>
<td>Slim Seal Butterfly Valve</td>
<td></td>
<td>AIP</td>
<td>AIP VALVES , Mr Manish Verma 9899016668</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AUDCO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>KSB</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Dual/Disk type Non Return Valves</td>
<td></td>
<td>AIP</td>
<td>AIP VALVES , Mr Manish Verma 9899016668</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AUDCO</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>KSB</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Fire Hydrant Valves, Branch pipe &amp; Fire man Axe.</td>
<td>5290</td>
<td>SAFE GUARD</td>
<td>Ashok Engineers</td>
</tr>
<tr>
<td>S. No</td>
<td>Materials</td>
<td>IS</td>
<td>Brand</td>
<td>Manufacturer / Approved Dealer</td>
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<td></td>
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<td>PADMINI</td>
<td>Padmini Industries</td>
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## Technical Specifications for Plumbing, Fire Fighting & Medical Gas System (MGS) Works

### LIST OF APPROVED MAKES OF MATERIALS WATER SUPPLY/FIRE FIGHTING PUMPS & EQUIPMENTS AND WATER TREATMENT UNITS

<table>
<thead>
<tr>
<th>S.No</th>
<th>Materials</th>
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<td>Labline Industrial Valve Mfg. Co., Mumbai</td>
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<td>S.S. Engineers Industries, B-29, Sector-7, NOIDA, Ph.: 91-525701, 91-526941</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Renuka Sales Corporation, New Delhi – 110 049, Tel: 2625 7262/2626 2346</td>
</tr>
<tr>
<td>38.</td>
<td>Electrical Panels</td>
<td>DEVCO</td>
<td>DEVCO ENGINEERS</td>
<td></td>
</tr>
</tbody>
</table>
86  IMPORTANT INSTRUCTION FOR QUALITY OF WATER

The successful contractor will have to carry out a test of raw water from all the sources of water for the Hospital at their own cost from a reputed lab as approved by the Engineer-in-Charge / Consultant. On the basis of these results the contractor has to submit his shop drawings, design calculations and specifications accordingly.

Please note that it is ultimately the responsibility of the contractor to provide treated water for different use in the hospital as per International Standard as given in the attached guidelines.

87  REQUIRED QUALITY OF TREATED WATER

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Characteristics</th>
<th>Acceptable as per Indian Standard of P.H.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Turbidity (Units on J.T.U scale)</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>Colour (Units on Platinum Cobalt scale)</td>
<td>5.0</td>
</tr>
<tr>
<td>3</td>
<td>Taste and Odour</td>
<td>Unobjectionable</td>
</tr>
<tr>
<td>4</td>
<td>pH</td>
<td>7.0 to 8.5</td>
</tr>
<tr>
<td>5</td>
<td>Total dissolved solids (mg/l)</td>
<td>500</td>
</tr>
<tr>
<td>6</td>
<td>Total hardness (mg/l) (as CaCO3)</td>
<td>200</td>
</tr>
<tr>
<td>7</td>
<td>Chlorides (as Cl) (mg/l)</td>
<td>200</td>
</tr>
<tr>
<td>8</td>
<td>Sulphates (as SO4)</td>
<td>200</td>
</tr>
<tr>
<td>9</td>
<td>Fluorides (as F) (mg/l)</td>
<td>1.0</td>
</tr>
<tr>
<td>10</td>
<td>Nitrates (as NO3) (mg/l)</td>
<td>45</td>
</tr>
<tr>
<td>11</td>
<td>Calcium (as Ca) (mg/l)</td>
<td>75</td>
</tr>
<tr>
<td>12</td>
<td>Magnesium (as Mg) (mg/l)</td>
<td>&gt; 30</td>
</tr>
<tr>
<td>13</td>
<td>Iron (as Fe) (mg/l)</td>
<td>0.1</td>
</tr>
<tr>
<td>14</td>
<td>Manganese (as Mn) (mg/l)</td>
<td>0.05</td>
</tr>
<tr>
<td>15</td>
<td>Copper (as Cu) (mg/l)</td>
<td>0.05</td>
</tr>
<tr>
<td>16</td>
<td>Zinc (as Zn) (mg/l)</td>
<td>5.0</td>
</tr>
<tr>
<td>17</td>
<td>Phenolic compounds (as Phenol) (mg/l)</td>
<td>0.001</td>
</tr>
<tr>
<td>18</td>
<td>Anionic detergents (mg/l) (as MBAS)</td>
<td>0.2</td>
</tr>
<tr>
<td>19</td>
<td>Mineral Oil (mg/l)</td>
<td>0.01</td>
</tr>
<tr>
<td>20</td>
<td>Arsenic (as As) (mg/l)</td>
<td>0.05</td>
</tr>
<tr>
<td>21</td>
<td>Cadmium (as Cd) (mg/l)</td>
<td>0.01</td>
</tr>
<tr>
<td>22</td>
<td>Chromium (as hexavalent Cr) (mg/l)</td>
<td>0.05</td>
</tr>
<tr>
<td>23</td>
<td>Cyanides (as CN) (mg/l)</td>
<td>0.05</td>
</tr>
<tr>
<td>24</td>
<td>Lead (as Pb) (mg/l)</td>
<td>0.1</td>
</tr>
</tbody>
</table>
### Technical Specifications for Plumbing, Fire Fighting & Medical Gas System (MGS) Works

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Characteristics</th>
<th>Acceptable as per Indian Standard of P.H.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>Selenium (as Se) (mg/l)</td>
<td>0.01</td>
</tr>
<tr>
<td>26</td>
<td>Mercury (total as Hg) (mg/l)</td>
<td>0.001</td>
</tr>
<tr>
<td>27</td>
<td>Polynuclear Aromatic Hydrocarbons (PAH)</td>
<td>0.2 ug/l</td>
</tr>
<tr>
<td>28</td>
<td>Gross Alpha activity</td>
<td>3p Ci/l</td>
</tr>
<tr>
<td></td>
<td>Gross Beta activity Pci = pico curie</td>
<td>30p Ci/l</td>
</tr>
<tr>
<td>29</td>
<td>Bacteriological Quality of piped water supplies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Treated water entering the distribution system</td>
<td></td>
</tr>
<tr>
<td>29.1</td>
<td>Faecal coliforms number/100 ml</td>
<td>0</td>
</tr>
<tr>
<td>29.2</td>
<td>Coliform organisms number/ 100 ml</td>
<td>0</td>
</tr>
</tbody>
</table>