

**CHHATTISGARH MEDICAL SERVICES CORPORATION
LIMITED**

(Government of Chhattisgarh)

Tender

For

Construction of 100 bedded MCH wing at Balod (CG.),
under National Rural Health Mission scheme

TECHNICAL SPECIFICATIONS

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Tender No. HSCC/NRHM/CG./2014 (IV) /01

TECHNICAL SPECIFICATIONS

CIVIL WORKS

1.0 GENERAL:-

- 1.01 The specifications and mode of measurements for Civil and Plumbing works shall be in accordance with C.P.W.D. specifications 2009 Volumes I and II with up to date correction slips unless otherwise specified in the nomenclature of individual item or in the specifications. The entire work shall be carried out as per the C.P.W.D. specifications in force with up to date correction slips upto the date of opening of tender.
- 1.02 For the item not covered under CPWD Specifications mentioned above, the work shall be executed as per latest relevant standards/codes published by B.I.S. (formerly ISI) inclusive of all amendments issued thereto or revision thereof, if any, upto the date of opening of tenders.
- 1.03 In case of B.I.S. (formerly I.S.I) codes/specifications are not available, the decision of the Engineer based on acceptable sound engineering practice and local usage shall be final and binding on the contractor.
- 1.04 However, in the event of any discrepancy in the description of any item as given in the schedule of quantities or specifications appended with the tender and the specifications relating to the relevant item as per CPWD specifications mentioned above, or in drawings the former shall prevail.
- 1.05 In general the building floor to floor height is 4.00 mtr unless specified otherwise in the drawing. However, the rates for different items of work shall be for up to 4.5 m floor to floor height at all levels, lifts, leads and depths of the building except where otherwise specified explicitly in the item of work or in special conditions appended with the tender. All works above the top most terraces (main) shall be paid under the level existing below (i.e. machine room, mummy etc)
- 1.06 The work shall be carried out in accordance with the architectural, structural, plumbing and electrical drawings etc. The drawings shall have to be properly co-related before executing the work. In case of any difference noticed between the drawings, final decision, in writing of the Engineer shall be obtained by the contractor. For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the Engineer and nothing extra shall be payable on this account.
- 1.07 All materials to be used on works shall bear I.S. certification mark unless specifically permitted otherwise in writing. In case I.S. marked materials are not available (not produced),

the materials used shall conform to I.S. Code or CPWD specifications, as applicable in this contract.

In such cases the Engineer shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the manufacturers shall be used unless otherwise specified. All materials shall be tested as per provisions of the Mandatory Tests in CPWD specifications and the relevant IS specifications. The Engineer may relax the condition regarding testing if the quantity of materials required for the work is small. Proper proof of procurement of materials from authentic manufacturers shall be provided by the contractor to the satisfaction of Engineer. Grade of cement used shall be OPC 43 Grade unless otherwise specified explicitly. The contractor shall get the Design Mix for RCC done by the labs approved by OWNER only. Reinforcement Steel used shall be of TMT Fe-500 unless otherwise specified.

- 1.08 In respect of the work of the sub-agencies deployed for doing work of electrification, air-conditioning, external services, other building work, horticulture work, etc. for this project and any other agencies simultaneously executing other works, the contractor shall afford necessary coordination and facilities for the same. The contractor shall leave such necessary holes, openings, etc. for laying / burrying in the work pipes, cables, conduits, clamps, boxes and hooks for fan clamps, etc. as may be required for the electric, sanitary air-conditioning, fire fighting, PA system, telephone system, C.C.T.V. system, etc. and nothing extra over the agreement rates shall be paid for the same.
- 1.09 Unless otherwise specified in the bill of quantities, the rates for all items of work shall be considered as inclusive of pumping out or bailing out water if required for which no extra payment will be made. This will include water encountered from any source such as rains, floods, or due to any other cause whatsoever.
- 1.10 Any cement slurry added over base surface (or) for continuation of concreting for bond is added its cost is deemed to have in built in the item unless otherwise/explicitly stated and nothing extra shall be payable or extra cement considered with consumption on this account.
- 1.11 The rate for all items in which the use of cement is involved is inclusive of charges for curing.
- 1.12 The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer before the work is considered as complete.
- 1.13 Rates for plastering work (excluding washed grit finish on external wall surfaces) shall include for making grooves, bands etc. wherever required and nothing extra shall be paid for the same.
- 1.14 The rates quoted for all brick/concrete work shall be deemed to include making openings and making good these with the same specifications as shown in drawings and/or as directed. No extra payment shall be made to the contractor on this account.
- 1.15 Rates for all concrete/plaster work shall include for making drip course moulding, grooves etc. wherever required and nothing extra shall be paid for the same.
- 1.16 Rates for flooring work shall include for laying the flooring in strips/as per sample or as shown in drawings wherever required and nothing extra shall be paid for the same.

- 1.17 The drawing(s) attached with the tender documents are for the purpose of tender only, giving the tenderer a general idea of the nature and the extent of works to be executed. The rates quoted by the tenderer shall be deemed to be for the execution of works taking into account the "Design Aspect" of the items and in accordance with the "Construction Drawings" to be supplied to the Contractor during execution of the works.
- 1.18 The quoted rate shall be for finished items and shall be complete in all respects including the cost of all materials, labour, tools & plants, machinery etc., all taxes, duties, levies, octroi, royalty charges, statutory levies etc. applicable from time to time and any other item required but not mentioned here involved in the operations described above. The client/OWNER/Employer shall not be supplying any material, labour, plant etc. unless explicitly mentioned so.
- 1.19 On account of security consideration, there could be some restrictions on the working hours, movement of vehicles for transportation of materials and location of labour camp. The contractor shall be bound to follow all such restrictions and adjust the programme for execution of work accordingly.
- 1.20 The contractor has to ensure co-ordination with Institute authorities to maintain the smooth functioning / operation of existing Institute without disruption during the execution of work. This may require working rescheduling the normal working hours, working in restricted period etc. Nothing extra shall be payable on this account.

He shall also ensure that all work sites within the Institute complex are properly cordoned off by means of barricades and screens upto a height of 3.0 m above ground level. The contractor shall use painted CGI sheets which are in good condition mounted on steel props.

- 1.21 Stacking of materials and excavated earth including its disposal shall be done as per the directions of the Engineer-in-Charge. Double handling of materials or excavated earth if required shall have to be done by the contractor at his own cost.

2.0 CHEMICAL RESISTANT EPOXY RESIN WALL COATING

MATERIAL

The system shall consist of 2 component solvent free, epoxy based, chemical resistant coating. The thickness of the coating shall be between 300 microns depending on the number of coats. The application of primer and coating is to be done as per the manufacturer's specifications.

a. A coat of primer shall be applied over clean, dry surface:

b. While the primer coat is tack-free, two topcoats of epoxy shall be applied:

APPLICATION/LAYING PROCEDURE

The surface should be properly cleaned and should be free from oil, grease, cement laitance and dust. The surface should be free from potholes, honeycombing, potholes & cavities. If defects are found, the surface should be prepared to a smooth finish.

The surface should be primed using epoxy primer Allow the primer to dry overnight so that it is track-free.

Top coat of epoxy should be applied in two coats to a thickness of 300 microns. The first coat should be allowed to become tack free before the second coat is applied.

The system should be air cured for a minimum period of 5 to 7 days to achieve the best results against loading & chemical resistance.

3.00 WATER PROOFING TREATMENT BY CHEMICAL INJECTION SYSTEM (PRECONSTRUCTION)

3.01 HORIZONTAL SURFACE (RAFT SLAB)

A. Before the raft reinforcement is placed in position:

1.1 Laying PCC as per drawings and specifications.(payable under the corresponding item)

1.2 Cement slurry (cement and polymer based water proofing compound) is spread on the PCC for proper bonding with subsequent water proofing treatment.

1.3 Water Proofing Course of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) mixed with polymer based water proofing compound is laid over the slurry. Stone aggregates 12mm down is embedded at random.

1.4 After 24 hours, spreading cement slurry (cement and polymer based water proofing compound) on the 1st layer of mortar.

1.5 Providing and laying 2nd layer of 20mm thick cement mortar 1:4 mixed with polymer based water proofing compound. Stone aggregate 12mm down is embedded at random.

1.6 After curing for two days, spread cement slurry mixed with water proofing compound over the 2nd layer of cement mortar. Thereafter, the 3rd and final layer of 20mm thick cement mortar in 1:4 mixed with water proofing compound is laid and finished smooth to receive raft foundation.

1.7 The total thickness of the treatment from operation 1.2 to 1.6 will be about 60mm.

B. After The reinforcement of raft is placed in position:

2.1 Providing and fixing 25mm dia GI threaded grouting nozzles of adequate length at the specified locations @ 1.50 metre c/c or as shown in the drawing all over the slab. The grouting nozzles are tied with reinforcement in such a manner as not to choke its end during concrete operations. The top of these nozzles protrudes above the raft concrete.

2.2 After minimum 7 days of concreting, cement grout of cement and polymer based water proofing compound (non shrinkage grouting compound) in proportion as specified is injected, through these nozzles at the pressure of 2.5 to 3.0 Kg/Sq.cm.

2.3 After grouting, top of the nozzles is cut and the space is filled with cement mortar 1:2 (1 cement: 2 coarse sand) mixed with polymer based water proofing compound.

3.02 Retaining Wall

1.1 The external surface is prepared and polymer based cement slurry is applied.

1.2 Providing and laying 25mm thick cement mortar in 1:4 (1 cement : 4 coarse sand) mixed with polymer based water proofing compound in two layers with chicken wire mesh 26 or 24 gauge 25mm size in between the two layers.

1.3 The G.I. pipes are placed at 1.5m c/c and at location indicated as per drawing and securely fastened to the reinforcement prior to shuttering and concreting or alternately by drilling holes (25mm to 32mm dia) in the concrete upto a depth as shown in the drawing all over the wall surface @ 1.50mt. c/c and as shown in the drawing. Treatment along all construction joints by providing nozzles, as above, shall also be executed.

1.4 Fixing 25mm dia G.I. threaded nozzles in these holes with cement mortar 1:4 mixed with water proofing compound.

1.5 Injecting cement grout of cement and polymer based water proofing compound (non shrinkage grouting compound) in proportion as specified in these nozzles at a pressure of 2.5 to 3.0 Kg/Sq.cm.

1.6 After the grout the nozzles are cut and filled with cement mortar 1:2 mixed with polymer based water proofing compound in proportion as specified and finished smooth.

Note: The proportion of acrylic based polymer compound to be used in respect of ordinary cement shall be 1% by weight.

Acrylic based integral water proof compound shall satisfy the provision IS: 2645.

Guarantee for water proofing:

Work to be get executed through a approved specialized agency & covered by a 10 years guarantee by the main contractor against leakage, seepage and dampness etc. for which necessary performance guarantee for requisite indicated value of work shall be furnished by the contractor before completion.

Measurements:

The length and breath shall be measured correct to cm. The flooring area shall be measured in sq.m. actually executed in raft slab. Inside wall surfaces of the basement upto ground level from top of raft slab shall be measured in sq.m.

Columns cross sections area not to be deducted from the plan area.

Rate:

Rates shall be inclusive of all operations including labour, material, T&P, scaffolding etc. complete. Nothing extra shall be payable on any account.

4.00 ALUMINIUM COMPOSITE PANEL METAL CLADDING

4.01 Scope of Work

The contractor shall design, supply, fabricate, deliver and install and guarantee all construction necessary to provide a complete aluminium composite panel cladding, complete with all necessary anchors, hardware and fittings to provide a total installation, fully in conformity with the requirements and intent of the drawing and specification as per item description.

The scope of work shall be read in conjunction with those in the specification of curtain walling.

4.02 Design Concept

- a) The proposed cladding shall be based on a water-tight system.
- b) A 20mm wide joint shall be provided between cladding elements to cater for individual panel installation and shall be sealed off with extruded EPDM gasket or silicon sealant.

4.03 Aluminium Composite Panel Cladding

Providing, designing, cutting, bending and fixing 4mm thick aluminium composite cladding of approved make on external façade of size as shown with Water tight system either curved or straight in plan. Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene, aluminium cladding panel to be of approved colour/shade fixed with extruded aluminium basic frame, angle cleats, weather sealants, rivets, GI brackets all as approved, using suitable chemical/anchor bolts on structural steel work including necessary accessories complete in all respects. Where level difference is shown dummy structural steel backup frame shall be provided. Protective Film: The finished surface shall be protected with 80 microns self adhesive Peel Off film with two layers of white and black tested to withstand at least 6 months exposure to local weather condition, without losing the original peel off characteristic or causing stains or other damages.

The quoted rate to include for any provision of openable access panels for services wherever required. Weather silicon sealant, non streaking /staining weather sealant shall also be used wherever required.

Technical Data

- A. Composition Skin material 0.5mm thick aluminium sheet (3005 H6) core material natural polyethylene.
- B. Dimensions Panel thickness : 4mm
Panel size: Width 1000/1250/1500mm

		Length between 1500 and 5000mm
		Tolerance
		Width \pm 2.0mm
		Length \pm 4.0mm
		Thickness + 0.02mm
C.	Principal Properties	Panel weight: 5.5 kg/sq.m Thermal expansion: 1mm/M/60 deg.C.
D.	Acoustic Properties	Average airborne sound transmission loss 26 db.
E.	Mechanical Properties	Tensile Strength RM > 160 MPa. 0.2% Proof stress RP > 130 MPa. Modulus of Elasticity E 70,000 MPa. Elongation A-50 – 5-7%
	Aluminium Extrusions	Extrusions shall be of aluminium alloy 6063 T5, conforming to BS-1470 – 1475 : 1972 in mill finish.

4.03.1 Design Wind Loading

850 N/m² positive and negative to Podium.
1150 N/m² positive and negative to Tower.
1500 N/m² positive and negative to Crown to Tower.

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified.

4.03.2 Deflection

Deflection of any aluminium frame shall not exceeding 1/175 of the clear span.

4.03.3 Expansion and Contraction

The cladding shall be so fabricated and erected as to provide for all expansion and contraction of the components. Any temperature change due to climatic conditions shall not cause harmful buckling, opening of joints, undue stress on fastening and anchors, noise of any kind or other defects.

4.03.4 Flatness

The cladding surface taken individually shall not have any irregularities such as oil canning, waves, buckles and other imperfections when viewed at any position but not less than at an angle of 15 degrees to the true plane of the panel with natural lighting of incident of not less than the same angle.

4.03.5 Water Tightness

The panel cladding shall be so constructed to be water tight with provision for rear ventilation.

4.03.6 Acoustic Treatment

The cladding panel system shall be designed so as to dampen noise caused by splashing water.

4.04 Fixings

- a) Fasteners including concealed screws, nuts, bolts and other items required for connecting aluminium to aluminium shall be of non-magnetic stainless steel.
- b) Rivets used for fastening panel to aluminium sub-frame shall be of alloy aluminium large flange head type with stainless steel mandrel.
- c) All fixing anchors, brackets and similar attachments used in the erection shall be of aluminium or non-magnetic stainless steel.

4.05 Weather seal

- a) All exposed joints between panel which require to be water tight shall be sealed with extruded EPDM gasket of hardness approx. 75 SHORE.
- b) All secondary weather seal shall be of self-adhesive tape as approved by Architects.

5.00 STRUCTURAL/CURTAIN WALL SYSTEM

5.01 SCOPE OF WORK

- A. The contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete curtain wall/structural glazing system to the proposed building, all in conformity with the Drawings as shown. 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 and/or

Without limiting the generalities of the foregoing, the Curtain Wall/structural glazing Systems shall include, without being limited to, the followings:

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

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

All thermal insulation associated with the system.

All fire protection associated with the system.

All copings, end closure and metal cladding to complete the system.

All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.

Isolation of dissimilar metals and moving parts.

Anticorrosive treatment on all metals used in the system.

Polyester powder coating aluminium sections.

B. The contractor shall also be responsible for providing the followings:

1. Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the Curtain Wall/structural glazing System.
2. Scheduling and Monitoring of the Work.
3. Mock-ups, samples and test units.
4. Performance Testing of the Curtain Wall/structural glazing framing and glazing assembly.
5. Co-ordination with work of other trades.
6. Protection.
7. All final exterior and interior cleaning and finishing of the Curtain Wall /structural glazing System
8. As-built record drawings and photographs.
9. Guarantees and Warranties.
10. All hoisting, staging and temporary services.
11. Conceptualising and design of a suitable maintenance system for curtain/structural glazing.

C. The water tightness and structural stability of the whole Curtain Wall /structural glazing System are the prime responsibility of the Contractor. Any defect or leakage found within the Guarantee Period shall be sealed and made good all at the expense of the Contractor.

D. The curtain wall/structural glazing 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.

5.02 BUILDING REGULATIONS

Curtain Wall/structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.

All curtain walling/structural glazing, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following:

- a) Design load and deflection.

- i) Curtain Wall/structural glazing construction in its entirety shall be fabricated and erected to withstand without damage or permanent deformation inward (positive) and outwards (negative) pressure, all acting normal to the construction plane with a maximum deflection of not exceeding 1/175 of the clear span between structural support or 20mm maximum whichever is less.
- ii) Structural performance of all parts of curtain wall/structural glazing system shall conform to relevant IS codes, wind load as per IS-875 and seismic loads as per IS-1893. Deflection shall cause no permanent set in excess of 1/1000 of span nor evidence of structure failure.

5.03 MEASUREMENTS

Measurements of the Curtain Wall /structural glazing shall be in the metric system in sq.m correct to two places of decimal. The area considered for measurement shall be net area as fixed on the exterior face of the curtain wall/structural glazing including open able windows as part of curtain wall/structural glazing. The contractor shall be responsible for verifying all the dimensions and actual conditions on site.

5.04 RATE

The rates shall include the cost of all the operations described above including the cost of all materials, labour, design, fabrication, erection, finishing, scaffolding and testing of water tightness etc.

5.05 TENDER DRAWINGS AND SPECIFICATIONS

The tender drawings indicate profile and configuration required together with relationship to structural frame and interior building elements.

The Specification and tender drawings is of the performance type and includes only the minimum requirements of the /structural glazing Wall System without limiting the Contractor to the method of achieving desired performance.

5.06 POST TENDER REQUIREMENTS

a) Design Proposals

The contractor shall propose the final design in such a way that all basic functional and architectural requirements are fulfilled and get the same approved by Deptt. However, basic design requirements as described in the specification and other Architectural requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

The design proposals shall be in the form of drawings, drawn to full scale as far as practical and specification shown in or describing all items of work including:

- i) Request details as indicated on the tender drawings.
- ii) Metal quality, finishes and thickness.
- iii) Glass quality, coating and thickness and proposed manufacturer's brand names.

- iv) Sections of the mullion and transom together with structural calculations.
- v) Arrangement and jointing of components.
- vi) Field connections especially mullion to mullion and transom to mullion.
- vii) Fixing and anchorage system of typical wall unit together with structural calculations.
- viii) Drainage system and provision in respect of water leakage in the curtain wall/structural glazing system.
- ix) Provisions for thermal movements.
- x) Sealant and sealing method.
- xi) Glazing method.
- xii) Wind load and seismic load and any other specific load considered in the design.
- xiii) Lightning protection link-up system of the curtain wall/structural glazing for connection and incorporation into the lightning conductor system of the building . Design concept must be stated in the proposal.

The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case this tolerance exceed those specified in the Specification.

Any parts of the curtain wall/structural glazing, when completed, shall be within the following tolerances:

Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m of length of any member, or 6mm in any total run in any line.

Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle, must not exceed 9mm total at any location.

Change in deviation must not exceed 3mm for any 3.5m run in any direction.

b) Samples

The contractor shall also submit samples of mullion and transom sections in lengths of 300mm with the same finish and workmanship along with the proposals and 300mmx300mm samples of glass (samples to include exposed screws and other exposed securing devices, if any).

c) Preliminary Programme

The tenderer shall also submit a preliminary programme of the contract works showing the various stages of design sampling, testing, fabrication, delivery and installation of the works.

d) Upon approval of the shop drawings, at least 4 copies shall be submitted by the Contractor.

e) The Contractor/Sub-contractor shall submit a maintenance manual for the curtain wall/structural glazing system inclusive of all metal parts, glass and finish etc.

- f) During detailed design and execution any details may increase as per actual requirement at site, these variations shall be executed without any extra cost implications to the client.

5.07 EXECUTION

Performance Testing

a) General Requirements

Mock-up units shall be constructed by the contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the façade.

After approval of structural calculations and shop drawings for the curtain wall/structural glazing, one (1) Test Unit for performance testing of the curtain wall/structural glazing shall be constructed by the contractor at a laboratory approved by the Department.

Erect mock-up under manufacturer's/installer's direct supervision and employ workmen as they would be employed during the actual erection at the job site.

Test procedures test schedules and test locations shall be submitted to Client for approval before testing.

Prior to fabrication of Test Units, the contractor shall submit shop drawings and calculations of the Test Unit for the Architect's approval.

Production for final job site erection shall not start until approval has been obtained as a result of the mock-up test.

b) Test of Wind Pressure

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.

The static wind pressure shall be applied up to 1.5 Kpa at maximum wind pressure.

The variation of dynamic pressure shall be of any approximate sine-cure-line.

Deflection on each observational points of the Test Unit shall be observed and recorded under the Static pressure as described above.

Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

The deflection on the main structural parts in these conditions shall not exceed:

1/175 of the span between supports or 20mm, whichever is the lesser for vertical elements.

1/250 of the span between supports for horizontal elements.

The extent of recovery of deformation 15 minutes after the removal of the test load is to be least 95%.

c) Test of Lateral Deflection Per Floor Height

Lateral deflection per floor height shall be occurred on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

The deflection of every + 2.5mm shall be increased upto + 13mm on the Test Unit (Static Deflection Test).

The dynamic deflection shall be applied upto + 13mm.

The variation of dynamic deflection shall be of an approximate sine-curve-line, one period of 3 seconds.

The dimension of the deflection on each observational points of the Test Unit shall be measured under the condition as described above, the damage shall be observed.

Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall/structural glazing except sealant at maximum deflection.

d) Test of Water-tightness

Water shall be sprinkled to the Test Unit under the wind pressure.

Pressure shall not be applied to the Test Unit.

The volume of the sprinkling water in one minute shall be 5 litres/m² min. (0.1 gal/sq/ft.).

All water leakage and drainage system at the joint and openable sash of the curtain wall/structural glazing system shall be observed from the outside of the chamber.

Hold the test 2 times, in sequence as described below, conforming to the above mentioned conditions.

Install the test unit.

Hold 1st water-tightness test.

Hold test of wind pressure as described above.

Host 2nd water-tightness test.

Lateral deflection test.

Water leakage at all parts of the Test Unit shall not be observed inside during the 1st water-tightness test.

e) Test Report

The Contractor is required to submit five (5) copies of test reports to the Client.

f) Cost of Performance Test

The Contractor shall allow in his tender for the cost of the performance testing and of fabrication, erection, corrections to and demolition of the Test Units including any special provision required in the testing laboratory for the tests mentioned above.

The Contractor shall allow for amendments and adjustments to the mock-up as required by the Employer.

If the Test Unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the Test Unit and shall have to get the Test Unit retested by the Testing Laboratory till it passes the tests.

Cost of corrections to the Test Unit and cost of re-testing shall be borne by the Contractor at no additional cost to the Employer.

g) Shop Drawings and Calculations for the Performance Testing

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for Client/employer's approval.

h) Record Drawings

The testing laboratory shall keep copy of approved Test Unit shop drawings and calculations at testing laboratory during testing of Test Unit.

The testing laboratory shall accurately and neatly record on the above mentioned shop drawings all changes, revisions, modification etc. made to Test Unit, which shall become the record drawings.

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the Client.

i) Contractor's Representatives

Full time attendance by Approved Representatives of the Contractor & subcontractor associated with the erection of curtain wall/structural glazing shall be provided for the erection of the Test Unit and for all testing of the Test Unit.

5.08 PERFORMANCE GUARANTEE

The tenderer shall provide a performance guarantee of requisite value to be indicated in the General Conditions of Contract for a period of five years, to provide for expenses, to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period to start from the date of completion of the project.

6.0 ACOUSTIC CELING

6.1 The acoustic tiles shall be procured from an approved manufacturer as directed by Engineer-In-Charge.

6.2 The tiles and the suspension system shall be as specified in the item nomenclature .The Contractor shall prepare the shop drawings for the False Ceiling based on actual measurements at site and based on the architectural drawings, clearly

indicating the typical panel as well as edge panel on all sides with details to adjust the minor variations in orthogonal. Also, junction details with different types of false ceiling materials shall be prepared and submitted for the approval of the Engineer-in-Charge before execution.

- 6.3 The installation shall be got done through a reputed interior contractor who shall be engaged by the Contractor. The false ceiling shall be perfectly level after installation.
- 6.4 The Contractor shall then prepare the mock-up at site for approval of material and quality of workmanship by the Engineer-in-Charge. Only after the approval of Mock-up, the Contractor shall start the mass work.
- 6.5 The acoustic tiles shall be of size 600x600 mm or as required as per the architectural drawings and as per the site requirements and shall be of the texture and physical & other characteristics as per approved brand. The tiles shall have NRC, humidity resistance, light reflectance, thermal conductivity and other properties as described in the BOQ item. The contractor shall obtain and submit to the Department the manufacturer's certificate for compliance of the acoustic tiles & the suspension system as per the manufacturer's specifications and also copy of the manufacturer's test report for the record.
- 6.6 The tiles shall be made of non-combustible bio-soluble wool and shall have finely granulated surface texture with virtually invisible micro-perforations as specified & as required for its performance. It shall meet the various performance parameters like aesthetics, acoustics (sound absorption), hygiene, humidity resistance, impact resistance, fire resistance, durability etc.
- 6.7 The tiles shall have precisely machined edges including edge treatment required for the installation depending on the type of suspension system grid of brand and manufacture as approved by the Engineer-in-Charge / Consultant and as per the architectural drawings. The openings of required size for light fittings; fire detection devices, sprinklers, AC diffusers etc. shall be suitably made in the tiles by cutting in an approved and workmanlike manner. For the purpose of measurement, no deduction shall be made in the area of false ceiling on this account. Also, nothing extra shall be payable on this account. The end tiles shall be cut to the required size in a workman like manner as per the site requirement. Nothing extra shall be payable on account of any wastage in the material and /or account of providing grid at closure spacing than 600mm c/c.
- 6.8 These tiles shall be fixed on to coordinated suspension ceiling system with supporting grids system that fully integrates with the ceiling tiles. It shall be ensured that the suspension system shall be suitable to take the entire incidental and dead loads and other authorized loads efficiently and shall not sag. The permissible sag shall be as per the British Standards BS 8290 - 1991. The Contractor shall provide a guarantee for 10 years against sag on account of defective material and / or workmanship.
- 6.9 The suspension system shall consist of hangers, main runners, cross tees, perimeter trims, wall connectors etc. The hangers shall be securely fixed to the structural soffit/slab/beams at spacing not more than 1200mm centre to centre by using electroplated Galvanized M.S anchor fasteners of 6 mm (minimum) diameter of approved make and of adequate capacity to carry the design loads. The main runners shall be fixed at spacing not more than 600mm centre to centre. The last

hanger at the end of each main runner shall not be placed more than 450 mm from the adjacent walls. Additional hangers shall be placed at a distance not more than 150 mm from the joint in the main runner on either side. The cross tees 600 mm long shall be centrally inter-locked between main runners to form 600 X 600 mm modules. The main runners shall have central notches to accommodate mitered joint of 600 mm long cross tees.

Additional runners and hangers shall be provided where change of direction is required as per the site conditions. All the hangers, runners, tees, cleats, brackets etc. required for fixing the false ceiling suspension system shall be of anti-corrosive hot dipped galvanized M.S sections with zinc coating not less than 170 gms per sq.m and shall be as per BS 2989. The Galvanized M.S runners, cross tees, perimeter trims/ edge profile etc. shall be powder/coil coated (the coating as per the manufacturer's specifications) matt finished, of required colour and shade. The cross tees shall be connected to the main runner by stab and hook type (clip in) installation. The runners and cross tees shall have mechanical stitching for enhanced torsional resistance and shall have mitred inter-section. Further, the grid system with main runners and the cross tees shall have 15 mm wide flanges with a 6 mm central recess with reveal profile, with colour all white with black or white reveal of brand as approved by the Engineer-in-Charge / Consultant. The hangers shall be mechanically pre-straightened and shall not be less than 4 mm diameter and of lengths as required for keeping minimum plenum depth as per the architectural drawings. It shall be suitably cut / tied off. The stainless steel level adjuster clips (spring steel, butter fly clips having suitable number and diameter of machine punched holes and bent to required profile) shall be provided on the hangers to achieve the level ceiling. The suspension hangers shall be vertical or near to vertical as far as possible. The hangers shall be suitably designed not to have distributed load more than 12.5 kg. per sq.m and shall have capacity to take incidental loads of fixtures, suspended signages etc. within the tolerance limit of deflection as specified in BS 8290. Providing additional hangers if any, may accommodate increased load.

- 6.10 The contractor shall ensure that the grid system is designed and installed to carry all incidental loads and no other unauthorized load shall be transferred to this system. The luminaries, air grills / diffusers, signage etc. shall be as far as possible independently supported to avoid any over loading of the ceiling system which may result in excessive deflection or twisting of grids. Any strengthening of grid system by providing additional hangers, fasteners, runners, cross tees etc. or providing additional bracing may be carried out as required for any specific locations or for specific purpose for which nothing extra shall be payable. Perimeter trims / edge profiles of required size and shape, powder/coil coated to required colour and shade, shall be installed at the suspension grid perimeter to completely enclose the ceiling and shall be properly secured to the walls at not more than 450 mm centre to centre using stainless steel screws and PVC sleeves. It shall be neatly jointed at all external and internal angles and over lap sections in a workman like manner with mitered joints.
- 6.11 The ceiling should be set out such that the perimeter boards or tiles are in excess of half a module so that the edge panels on both the sides are of equal sizes as far as possible. The tiles shall be cut to required size and shape with rebates as specified using hand tools or mechanically operated tools in a workman like manner but with all precautions as per the manufacturer's specifications regarding generation of dust and ventilation.

- 6.12 The contractor shall ensure that the material is procured and delivered at installation site without any damage. Adequate care shall be taken before installation as well as afterwards till handing over the building for occupation. It shall be protected from rains, excessive humidity, chemical fumes, vibrations, dust etc. The contractor shall ensure careful handling and storage and prevent any rough handling, rolling of cartons or dropping cartons to prevent any edge damage or breakage. Any tile with edge damaged or crack etc. shall not be allowed to be used in the work and shall be replaced by the contractor at his own cost. Similarly, adequate care shall be taken by the contractor while placing or removing and handling the tiles so as not to cause any damage. Also, the contractor shall direct his interior contractors to take adequate precautions to prevent the tiles from any dirt, fingerprints, any other marks / splashes etc. The ceiling shall not be wet cleaned. Abrasive cleaners shall not be used to clean the marks.
- 6.13 The item of false ceiling includes cost of all inputs of labour, materials, wastage if any, T&P, scaffolding, staging or any other temporary enabling structure / services etc. and all other incidental charges including making necessary cut outs for A.C diffusers, Light fittings, grills, Fire detection, alarm, sprinklers devices and fittings etc. No deduction in the area shall be made for openings nor any thing extra shall be payable for making the openings. Also nothing extra shall be payable on account of any wastage in materials. Also nothing extra shall be payable on account of any strengthening of the supporting suspension system for the false ceiling, around the openings in the false ceiling by using additional hangers, fasteners, runners, cross tees, etc.

7.0 FIRE RATED DOOR SHUTTER, FRAME AND FITTINGS

Door Shutter

Fully insulated wooden fire rated shutter of minimum 120 minutes fire rating shall conform to BS: 476 part 22 and IS:3614 Part II as per the prototype tested and certified by CBRI Roorkee. The fire check door shall not collapse during the rated period of the fire under the specified fire conditions.

Thickness of door shutter 55mm thickness,

Door Leaves shall be constructed of 75mm x 49mm hardwood internal timber frame work, with infill of 96 kg/m³, ceramic fiber blankets of approved quality, coated with intumescent coating on both sides for insulation. The coated insulation shall be sandwiched between 12mm thick, Non combustible calcium Silicate boards of approved quality provided on both sides (edge to edge on internal Hardwood frame) and clad with 3mm thick commercial ply of approved quality & 1mm thick laminate of approved shade, brand and manufacture on both sides. 2nd class teak wood lipping of size 55mm x 14mm shall be provided all round the shutter. The shutter shall be made suitable for mounting on the fire rated wooden door frame.

Door Frame

Door frames of minimum 120 minutes fire rating shall conform to BS: 476 part 22, IS:3614 Part II as per the prototype certified by CBRI Roorkee

Door Frame will be made out of 2nd class Teak Wood (Ivory Coast) frame of section 140x65mm, with heat activated intumescent fire seal strips of size 20 x 4 mm (for smoke sealing) provided in grooves on all three sides of the frame with one coat of fire retardant primer of approved brand including two coats of fire retardant paint un thinned on cleared hard wood surface of door frames (@3.5 sq.m. per litre per coat) including preparation of base surface as per recommendations of manufacturer to make the surface fire retardant.

The frame shall be fixed with 8 nos. 100 mm long, 10 mm dia metal dash fasteners of approved brand and manufacture or as per direction of Engineer in charge

Both frame and shutter shall be fitted with fire & smoke intumescent seal of Viper or equivalent make of size 20 x 4mm on all the three sides except bottom. The pasting of the ply/veneer/laminate must be done using automatic machine and should be free from any nails or perforations. The board shall be Resistant to vermin, mould growth, minor impact, abrasion and short term water attack. The shutter shall be fixed with the frame with the help of SS 304 grade ball bearing hinges of size 100x76x2mm with necessary stainless steel screws and making cut out for vision panel. Provisions/reinforcement for fixing all fixtures shall be built in on the door prior to the supply.

Prototype Test certificate for fire rating of doors from CBRI, Roorkee for earlier tested design shall be attached along with manufacturers test certificate. Provisions/reinforcement for fixing all fixtures shall be built in on the doors prior to the supply.

Testing: The Client holds the right to get the door tested for fire rating at the cost of the contractor/vendor. In case the Engineer-in-charge desires to get the doors tested then one door including shutter, frame and all fittings shall be selected at random out of the entire lot and shall be tested for two hour fire rating. The testing shall be got done from CBRI, Roorkee. The cost of material for testing and transportation / packing & other incidental testing charges shall be borne by the contractor. In case the door fails to meet the requirement, the entire lot shall be rejected.

Measurement:

Final finished area of door shutter shall be measured after fixing it with the frame in the opening correct to one cm. Final finished length of door frame shall be measured after fixing it in the opening correct to one cm. NOTE:- cost of fire seal strips, dash fastners are included in the item. Nothing extra shall be paid if size of any component of material exceeds the limit mentioned in the item. The rates shall be inclusive of all materials, T&P, Labour, etc. complete including the cost of fittings, testing etc. as described above.

Fire rated glass

6 mm thick piroshield fire rated clear glass of approved make, of 120 minutes fire rating having a minimum 13 mm square electrically welded chemically treated steel wire mesh of dia 0.51 mm sandwiched in the centre during the continuous rolling process shall be fixed in vision panel

Area of glass shall be measured correct to 5 mm. Rate for the item includes the cost of glass, fire rated gasket channel and moulding/beading etc. all complete.

Fire rated panic exit device

UL listed fire rated single/double leaf panic exit devices tested in accordance with BS EN 1125: 1997 & BS EN 179: 1997, EN 1670 (Corrosion Resistant), & BS 476 Part 22 (for fire rating) shall be provided at fire staircase locations. The device shall be fixed with necessary hardware as recommended by the manufacturer. A minimum one year warrantee is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

Fire rated door closer

Fire rated door closer tested in accordance with BS:476 Part 22 (for fire rating) and BS EN 1154 shall be provided wherever required. The door closer shall be fixed with necessary hardware as recommended by the manufacturer. A minimum one year warrantee is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

Fire rated mortice lock

2 hrs, fire rated mortice lock with lever handle tested in accordance with BS:476 Part 22. A minimum one year warranty is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

Pull handle

300 mm long stainless steel grade 304 D type pull handle shall be fixed with necessary screws etc. complete. A minimum one year warranty is required for the product. The measurement shall be made in numbers of the item provided, which includes all the costs involved in materials and labour as described above.

8.0 PVC FLOORING

PVC Sheet Flooring

Materials

The PVC Flooring Material shall conform to IS : 3462. 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

Vinyl chloride copolymer

The polymeric material shall be compounded with suitable plasticizers and stabilizers.

Thickness: The thickness of PVC sheet shall be as per BOQ item.

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

The thickness of the specimen shall be measured at twenty scattered points.

Tolerance

- | | |
|------------------------------|--------------|
| a) Thickness | ±0.15 mm |
| b) Width of Sheets and Rolls | ±0.1 percent |

Adhesive : Rubber based adhesive are suitable for fixing PVC flooring over concrete, wooden and metal sub-floors. PVA based adhesives shall be used for concrete and wooden subfloors. 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 Lying PVC Sheets, it is essential to ensure that the base is thoroughly dry and damp proof as evaporation of moisture can't take place once the PVC flooring is laid. Moisture slowly damages the adhesive resulting in PVC sheet 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.

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.

Laying and Fixing

Prior to laying, the flooring 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.

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 backside of the PVC sheet or tile flooring. When set sufficiently for laying, the adhesive will 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 area of 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 5 kg 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.

Any adhesive which may squeeze up between 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.

The joints between the sheets shall be hot welded using a suitable welding rod so that the flooring becomes jointless. The welded shall be so done as not to harm the sheet in any way.

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 or tiles are exposed, as 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.

The work shall also be carried out in skirting/ coving as per drawing/ instructions of the engineer/ architect.

Measurements

Length and breadth of flooring, skirting and/ or coving shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for void not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for providing PVC flooring in borders, margins, skirting/ coving irrespective of their width.

Rate

The Rate shall include the cost of all materials and labour involved in all the operations described above. The rate does not include the cost of sub-floor or damp proof treatment if any. It also does not include the cost of metallic edge strip to protect edge of flooring, wherever provided, it shall be paid separately.

9.0 STAINLESS STEEL RAILINGS

- 9.1 The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.
- 9.2 The stainless steel work shall be got executed through specialized fabricator as per the list of the approved agencies having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-in-Charge.
- 9.3 The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.
- 9.4 The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-in-Charge / Consultant. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge / Consultant. The mock-up

shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge. Nothing extra shall be payable on this account.

- 9.5 The stainless steel shall be of grade S 304 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.
- 9.6 The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.
- 9.7 One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.
- 9.8 The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using non abrasive approved cleaner for the material. Nothing extra shall be payable on this account.
- 9.9 The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.
- 9. 10 The railing shall be fixed in position using stainless steel pipes, stainless steel posts of grade S 304 of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

10.00 Mix Design, Batching Plant/ Ready mix Concrete

- 10.1 Following parameters shall be adopted for mix design in moderate exposure.

1.	Nominal Maximum size of aggregate	20mm angular as Per CPWD specification
2.	Degree Of quality control	Good
3.	Type of Exposure	Moderate
4.	Maximum water cement/ratio	0.50
5.	Type of cement to be used	OPC 43 grade conforming to IS: 8112

6.	Sand	Coarse Sand as per CPWD specification
7	Use Of Fly Ash in RMC	Strictly not permitted.

10.2 **BATCHING PLANT:** Batching Plant of suitable capacity to be installed within a period of 30 days from award of work. The contractor shall install batching plants (within 50 meters distance from the site of work) supplying Concrete at site. The batching plant proposed to be engaged by the contractor shall fulfill the following requirements.

- i) It shall be fully computerized.
- ii) Facility to pump concrete upto the highest point of the building.
- iii) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
- iv) Should have sufficient capacity to meet the requirement as per schedule.

In case of failure of Batching Plant, RMC may be allowed with a written permission of Engineer in Charge

10.3 Approved admixtures conforming to IS.9103 shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of BS 5075. The total amount of chloride content in the admixture mixed Concrete shall satisfy the requirement of IS 456-2000.

10.4 The concrete mix design with and without admixture will be carried out by the contractor through one of the following Laboratories / Test house to be approved by Engineer.

- i) IIT,
- ii) Shri Ram Institute of Industrial Research, Delhi
- iii) Any other Govt Laboratory as approved by Engineer.

10.5. In the event of all the above laboratories being unable to carry out the requisite design /testing, the contractor shall have to get the same done from any other reputed laboratory with prior approval of the Engineer.

10.6. The various ingredients for mix design \laboratory tests shall be sent to the lab test house through the Engineer and the sample of such ingredients sent shall be preserved at site by the department till completion of work or change in Design Mix whichever is earlier. The sample be taken from the approved materials which are proposed to be used in the work.

10.7. The rate for the item of Ready Mixed Concrete shall be inclusive of all the ingredients including admixtures if required, labour, machine T&P etc (except shuttering which will be measured & paid for separately) required for design mix concrete of required strength and workability.

The rate quoted by the agency shall be net & nothing extra shall be payable in account of change in quantities of concrete ingredients like cement and aggregates and admixtures etc. in the approved mix design.

10.8. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) to supply RMC for the work. The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements.

- i) It shall be fully computerised.
 - ii) It should have supplied RMC for Govt. projects of similar magnitude.
 - iii) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.
- 10.9. The contractor shall, within 10 days of award of the work submit list of at least three RMC plant companies from the approved makes along with details of such plants Including details of transit mixer, pumps etc. to be deployed indicating name of owner/company, its location, capacity , technical establishment, past experience and text of MOU proposed to be entered between purchaser (the contractor) and supplier (RMC Plant) to the Engineer who shall give approval in writing (Subject to drawl of MOU).
- 10.10. The Engineer reserves the right to exercise over the:-
- i) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials recordings of test results and declaring the material fit or unfit for use in production of mix.
 - ii) Calibration check of the RMC.
 - iii) Weight and quality check on the ingredient, water and admixture added for batch mixing.
 - iv) Time of mixing of concrete.
 - v) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.
- For exercising such control, the Engineer shall periodically depute his authorized representative at the RMC plant. It shall be the responsibility of the contractor to ensure that the necessary equipment manpower & facilities are made available to Engineer and/or his authorized representative at RMC plant
- 10.11. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.
- 10.12. All required relevant records of RMC shall be made available to the Engineer or his authorized representative. Engineer shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor & the RMC plant.
- 10.13. 43 grade OPC (Conforming to IS-8112) of brand/make/source approved by Engineer shall only be used for production of concrete.
- 10.14. It shall be the responsibility of the Contractor to ensure that the RMC producer provides all necessary testing equipment and takes all necessary measures to ensure Quality control of ready -mixed concrete. In general the required measures shall be:-

i) **CONTROL OF PURCHASED MATERIAL QUALITY**

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the material Supplier and the

requirement of the product mix design and quality control producer's. This shall be accomplished by visual checks, sampling and testing, certification from materials suppliers and information /data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

ii) **CONTROL OF MATERIAL STORAGE**

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed system, drainage of aggregates, prevention of freeing or excessive solar heating of Aggregate etc,

iii) **RECORD OF MIX DESIGN AND MIX DESIGN MODIFICATION**

RMC producer shall ensure that record of mix design and mix design modification is available in his computer at RMC plant for inspection of Engineer or his representative at any time.

iv) **COMPUTER PRINT OUTS OF EACH TRUCK LOAD**

Each truckload / transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer or his representative at site before RMC issued in work.

v) **TRANSFER AND WEIGHING EQUIPMENT RMC**

Producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by the Engineer in writing to contractor. RMC producer shall also maintain a daily production record including details of mixes supplied. Record shall be maintained of what materials were used for that day's production including water and admixtures.

The accuracy of measuring equipment shall be within +2% of quantity of cement +/- 3% of quantity of aggregate, admixture and water being measured.

vi) **MAINTENANCE OF PLANT, TRUCK Mixers AND PUMPS**

Plant, Truck Mixers and Pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

vii) **PRODUCTION OF CONCRETE**

The following precautions shall be taken during the production of RMC at the plant

i) Weighing (correct reading of batch data and accurate weighing) :- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to load the delivery tickets number for that load and the time of loading the concrete into the truck.

ii) Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability adjustment to water content. The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

iii) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregates or the workability of the concrete, cube tests etc. shall also be ensured.

iv) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.

v) Sampling of concrete, testing monitoring of results.

vi) Diagnosis and correction of faults identified from observations /complaints.

The RMC plant produced concrete shall be accepted by Engineer at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

10.15. The rate for the Item of design mix cement concrete shall be inclusive of all the ingredients including admixtures if required, labour, machinery T&P etc. (except shuttering which will be measured & paid for separately) required for a design mix concrete of required strength and workability. The rate quoted by the agency shall be net & nothing extra shall be payable on account of change in quantities of concrete, ingredients like cement and aggregates and admixtures etc. as per the approved mix design.

10.16 Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer.

10.17. Frequency of sampling and standards of acceptance shall be as per CPWD specifications.

i) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.

ii) The RMC shall be placed by pump of suitable capacity and the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractor shall co-ordinate with RMC supplier and pumps hirer to have effective concrete placement.

iii) Pre-paid delivery tickets shall be produced with each truck load of RMC.

iv) The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer

10.18 i) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. In case excess RMC is received at site, the department shall not be under any obligation to get extra quantities utilized and no payment for such RMC shall be made.

ii) The contractor shall have to employ labour in shifts to ensure continuous casting of raft and other RCC members. No extra payment on this account shall be made.

11.0 LAMINATED FLOORING

Manufacturing Standards

Laminate flooring panels must be manufactured in conformance with the European Standard of Laminate Flooring EN 13329:1998. The European Standard Specifies characteristics, requirements, and gives test methods for laminate floor coverings. It includes a classification system, based on EN 685, giving practical requirements for areas of use and levels of use. Laminate flooring panels must be abrasion tested according to the above standard and meet or exceed the requirements for the Abrasion.

Preliminary

Remove wrapping and lay flooring panels out flat at room temperature for 48 hours. Check all panels for defects. and ensure the surface to be covered with panels is clean, smooth, and level. Uneven areas must be levelled. Do not install over carpets. Remove carpet along with any residual adhesive material and install on smooth, firm surface.

Concrete Surfaces

A 'Patch Test' must be performed on concrete sub-floors. If there is any evidence of moisture, the concrete must be treated with an appropriate sealer. **NOTE:** DO NOT install laminates floor if patch test reveals moisture build up, until concrete is sealed.

It is recommended that a moisture barrier (Poly) be placed all over concrete sub-floors to protect against any possible moisture emissions.

Moisture Barrier

To protect panels against moisture form surfaces where moisture is likely to occur, a moisture barrier must first be placed over the base surface. Use 6-milH (0.2mm) polyethylene film. Overlap the edges of the polyethylene by a minimum of 8 inches and seal the junction with moisture proof self-adhesive tape. Use on concrete floors and at floors below grade or other areas where condensation or moisture emission may occur.

A moisture barrier should be installed over floors with radiant heat. Before laying the barrier, turn heat down to 16 C (60 F) one week before. Keep the temperature below 27 C (80 F) at all times.

Underlayment

Panels must be installed on top of underlayment .Use a good quality underlayment (Cork or High Density Foam). Underlayment seams should not overlap and should be taped with self-adhesive tape. If installing both a moisture barrier and underlayment, place the underlayment on top of the moisture barrier, or preferably use a reliable combination product. **Underlayment** - is a clear thin plastic sheet that is installed over the substrate before the laminate floor is floated. The plastic sheet helps the laminate floor to float freely above the substrate.

Installation

First Row: Measure the row before the first panel. Cut the first panel according to the length required for the last panel. Measure for straightness and cut the panels to make sure the inner edge of the first row panels is square before starting second row. Measure the last row of the panel width first. Then cut first row panels to the same width as the last row. Position the first row panels along one wall, leaving space for expansion between panels and the wall. Lock the ends of the panels together until the first row is finished.

Second Row: The first panel of the second row should be long enough so the ends of the second row panels reach past the end seams of the first row panels. If the remaining section of the last panel of the first row is long enough, use it for the first panel of the second row; Line up the first panel of the second row so the outside end is even with the outside end of the first panel of the first row. After locking in place, lay the remaining panels of the row by first

locking the long side in place and then tapping the end of the panel and slide it into firmly into place at its end; and

Lay each of the panels of the remaining middle rows.

Last Row: Because the width of the last row may be less than that of the previous rows, it may be necessary to cut the panels of the last row to the appropriate width .See instructions for first row

Expansion

Because changes in heat and humidity will cause laminate panels to expand and contract in both length and width, expansion spaces must be allowed on all sides of the installed floor. The use of spacers inserted between the panels and perimeter wall is recommended. The spacers should be removed after the panels are installed and before mouldings are attached to the walls. For rooms up to 25 feet (7.6 meters) in width and 40 feet (12.2 meters) long, allow for expansion between 3/8” and 5/8” (10 mm to16 mm) along each wall.

Expansion Joints

For floors more than 25 feet (7.6 meters) wide or more than 40 feet (12.2meters) long, an additional expansion joint must be inserted. Expansion joints are also required in doorways, and between adjoining rooms or areas where adjacent flooring is installed. Use a T- moulding to cover the expansion joint.

Pipes And Other Obstacles

When installing a laminate panel around a pipe or other obstacle, leave the same expansion gap as you would next to a wall, Measure and, precut the affected panel If there is condensation from pipe, cut the panel so there is sufficient space to keep the panel dry. Fill the space around a pipe with a caulking in order to protect the exposed (cut) edge of the panel.

Directions of Panels

For appearance, panels should be installed so the length direction of the panels is the same as the length direction of the room or as shown in the drawing.

Preparation

- Measure doors for clearance of Installed panels. Cut away doorframe and jambs at the bottom if necessary. Remove existing baseboards.
- Surface should be clean, smooth, and level surfaces with slopes steeper than 12.5mm over 1.62m (1/2* over 5') must be levelled. Measure the perimeter of the room to determine room's squareness, and the required width of the last row of panels. Allow for expansion gaps along each wall.
- Install tongue-and-groove panels, attach the tongue on one panel to the groove side of the other panel and the panels will lock snugly together.
- Start with the panel flat on the floor, decor surface up, and the groove side away from the wall. Insert the tongue of the second panel partially into the groove on the first, while holding the second panel at about a 20 angle from the floor. Press the second panel down and use a hammering block to lock firmly into place. (Reverse the procedure to release.) Continue in a similar fashion for the remaining panels.

Mouldings

Transition moulding should be used for the following purpose:

Reducer: Use in from laminate floor to linoleum or other type of hard surface.

T4Moulding: Use In doorways, between rooms and with adjacent floors, and expansion joints.

Stair Nosing: Use at the edge of each step in a staircase.

End molding: Use for transition form laminate floor to other types of floor covering,

Baseboard: Use at the base wail.

NOTE: Always fasten baseboard to the wall, never to the floor.

Measurement:

Length and breadth shall be measured correct to a centimeter. Height of dado shall be measured correct to a centimeter, and the height of skirting shall be measured correct to 5 mm. The area shall be calculated in sqm. Correct to two places of decimals. Length and height shall be measured along the finished face of skirting or dado.

Rates:

The rate of above item shall include the cost of all material and labour involved in all the operations described above.

12.00 HOLLOW METAL STEEL DOOR WITH HONEY COMB CORE

GENERAL

The Contractor shall furnish all materials, labour, operations, equipment, tools & plant, scaffolding and incidentals necessary and required for the completion of all metal work in connection with steel doors, as called for in the drawings, specifications and bill of quantities. The supply and installation of additional fastenings, accessory features and other items not specifically mentioned, but which are necessary to make a complete functioning installation shall form a part of this contract.

All metal work shall be free from defects, impairing strength, durability and appearance and shall be of the best quality for purposes specified made with structural proprieties to withstand safety strains, stresses to which they shall normally be subjected to.

All fittings shall be of high quality and as specified and as per approval.

The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code or its Equivalent British Standard and the provisions of the safety code and the provision of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials.

Any approval, instructions, permission, checking, review, etc., whatsoever by the PMC/AEC, shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, quality, workmanship, etc.

FRAME

- a) **Material** – Frame to be manufactured from 1.25 mm (18 gauge) glavanised steel sheets complying with latest IS 277 Code of GPL Grade with Z 120 Coatings or its Equivalent British Standard.
- b) **Profile** - Door frame profile to be single rebated of dimensions 100 mm X 57 mm (+ / - 0.3) with bending radius of 1.2 mm.

- c) **Manufacture** - Frame to be manufactured from 1.25 mm thick galvanised steel sheet to the specified profiles and dimensions. Frames manufactured at factory shall be mitred & knock down form with butt joints assembly at site.
- d) **Door frame preparations** – Frames to be provided with a 3 mm thick soffit back plates on all jambs with provision for anchor bolt fixing to wall openings. All frames to have reinforcement pads for fixing of door closer, at appropriate location as per manufacturer's details.
- e) Frames to have factory finish-pre-punched cut outs to receive specific hardware and ironmongery.
- f) Frames to be provided with hinge plates 3 mm thick pre-drilled to receive hinges for screw mounted fixing. All cut outs including hinge plates, strike plates to have mortar guard covers from inside to prevent cement, dust ingress into cut outs at the time of grouting.
- g) Frames to have rubber shutter silencer on strike jambs for single shutter frames and on the head jambs for double shutter frames.

h) **Finish**

Door frames to be suitably cleaned with solvents for receiving self etching primer and top coats.

Door frames to be primered in zinc phosphate stoving primer (35 microns DFT).

Door frames to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

DOOR SHUTTER

a) **Material**

General purpose door shutter to be manufactured from 0.80 mm (22 gauge) galvanized sheets conforming to latest IS : 277 Code of GPL Grade with Z 120 Coating or its Equivalent British standard.

b) **Manufacture**

Shutters to be press formed to 46 mm thick double skin hollow door with lock seam joints at stile edges. Shutters to have no visible screws or fasteners on either face.

c) **Door shutter core**

Shutters to be provided with honeycomb paper cored to be bonded to the inner faces of the Shutter.

d) **Door shutter preparations**

Shutters to be factory prepared with pre-punched cutouts and reinforcements to receive ironmongery as per final finish hardware schedule. The shutter should have an interlocking arrangement at this stile edges for flat surface on either side.

Shutters to have pre-drilled hinge plates with hinge guard covers. Shutters with locks to have concealed lock box with lock fixing brackets with pre-tapped holes.

All ironmongery preparation to have adequate reinforcement for flush fixing at site.

e) For shutter with door closer reinforcement pads to be provided at appropriate location as per manufacturer's design.

f) **Vision panel**

Vision panel to be provided with clear toughened glass of the thickness 6 mm. Glass to be fixed with clip on frames for square and rectangular vision panels and with spin turned rings for circular vision panels and Glazing Tape with one side adhesive. Vision Panels to be fixed with clip-on frames for square and rectangular Vision Panels with no visible screws. Unless otherwise specified standard sizes are 200 mm x 300 mm, 300 x 750 mm, 450 x 750 mm and 360 mm diameter.

g) Finish

Shutters to be suitably cleaned with solvents for receiving etching primer and top coats.

Shutters to be primered in zinc phosphate stoving primer (35 microns DFT).

Shutters to be finished in thermo setting Polyurethane paint (35 microns DFT) of approved colour and make as specified.

PACKING

a) Frame

Individual frames members to be protected with Co-extruded PE film, with low tack adhesive. PE film to be minimum 56 micron thick, abrasion resistant with 6 months UV resistance Capability. (Manufacturers Test Report to be submitted) and placed in individual card board boxes. Individual boxes to be sealed. Frames to be assembled at site with aid of roofing bolts.

b) Shutters

Shutters to be protected with Co-extruded PE film, with low tack adhesive. PE film to be minimum 56 micron thick, abrasion resistant with 6 months UV resistance Capability. (Manufacturers Test Report to be submitted) and packed in card board and strapped. All frames and shutters duly marked as per door schedule for easy identification at site.

STORAGE

All knocked down frames shall be stacked flat and shutters vertically on wooden runners and suitably covered as per the instructions of manufacturer to prevent rust and damage.

INSTALLATION

i. Door frame fixing

The door frames should be assembled adjacent to the place of installation as the frames are not designed for transporting in an assembled condition. After assembly it is to be ensured that all threaded preparations are covered from the back of the frame using self adhesive strip to prevent penetration of mortar back-fill into screw threads. The head member of assembled frame shall be positioned against jambs ensuring correct alignment and secured using M8 x 20 long plated bolts together with nuts spring and flat washers.

The assembled frame shall be kept in position within the opening by means of bracing. In order to correctly position the frame against finished floor level or equalise on adjustable floor anchors where specified, shim shall be used under jambs. The frame shall be checked for squareness, alignment, twist etc. with carpenters bevel and plumb.

A tie rod shall be fixed to the frame during installation to ensure the correct dimensions between the frame rebated and the same may be removed after installation.

Where a 2nd fix application is required a shim detail is suggested to take up gap between frame and existing opening.

Existing masonry wall openings – Metal expansion shields

- a) Brace, position, level etc.
- b) Mark all positions of fixings on wall.
- c) Remove frame and drill wall to appropriate specified size.
- d) Fit rod anchor shells metal expansion bolts into the wall.
- e) Fit jamb spacer bracket into back of frame profile.
- f) Reposition frame back into opening and realign.

- g) Lightly screw CSK HD machine screws into shells, shim behind frame.
- h) Slowly tighten screws continually checking plumb, square etc. Finally ensure frames are not deformed as tightened.
- i) After fixing the frame shall be grouted with cement mortar 1:3 or Plaster of Paris or Gypsum powder as approved. Gap between frame and wall to be closed by cement pointing using cement mortar 1:3.
- j) Back full the frame through holes provided and insert nylon plugs.

Door shutter fixing

- k) Fix all the hardware to the door shutter like hinges, flush bolts, bolts, mortice locks, door closer, door stoppers, handles etc. with the appropriate screws and bolts supplied. The shutter is to be then fixed to the frame which is already installed. Align the shutter to match the hardware to the cutouts in the frame. Tighten the hinge screws.

Measurements

Area of door shall be measured for payment .Area in Sqm shall be calculated by multiplying width & height as given below.

Width shall be measured correct to 1cm from outer to outer of door frame, measured horizontally

Height shall be measured correct to 1cm from top most of door frame to bottom of door shutter, measured vertically.

Rate of items includes the cost of all materials, labour and T&P involved as given in the BOQ item and specifications.

13.0 EPOXY BASED JOINTLESS ANTISTATIC FLOORING

The joint less flooring consists of 3 mm thick epoxy resin based antistatic flooring, self levelling with smooth finish, in required shade and of required conductor loading. Epoxy based flooring should be applied in several layers in order to insure permanent connection for the elimination of static electricity between the supporting base and the surface and should conform to IS: 9197. The entire job is to be undertaken by manufacturer’s trained and skilled technicians to lay the epoxy-based floor as per IS: 4631.

The top layer of epoxy resin in 3 or more coats in the desired colour and shade is applied so as to achieve the required thickness, shade and finish.

The mechanical parametric properties to be achieved are as follows.

Resistance to compression	800 Kgf/Cm2
Resistance to deflection	400 Kgf/Cm2
Resistance to abrasion	0.35 g/h
Fire behavior	Class IV/1
Resistance to current leakage	1.10 Ohms

Measurements will be done for the finished and completed area to the nearest centimeter.

ANTISTATIC EPOXY FLOOR TOPPINGS

MATERIAL DESCRIPTION

The heavy-duty abrasion, chemical resistant & antistatic epoxy screed flooring shall be an epoxy Self leveling screed, which is laid to a thickness of 3mm. This shall be extremely monolithic, seamless, jointless and is ideally suited for areas requiring Resistance to leakage of Current of 10^4 to 10^8 ohms.

- a. A coat of primer as mentioned below shall be applied over clean, dry concrete surface:

ANTISTATIC EPOXY PRIMER - Component A (Resin) (182gm)
ANTISTATIC EPOXY PRIMER - Component B (Hardener) (68gm)

- b. While the primer coat is still tacky, a 3 component, antistatic chemical resistant epoxy SCREED AS BASE COAT is to be applied with following materials @2.0kg/sqm

- Component A (Resin) (0.84kg)
- Component B (Hardener) (0.32kg)
- Component C (Graded Filler) (0.84kg)

- c. Over this a 2 component final top coat of antistatic SCREED AS is to be applied @3.5kg per sqm in two layers
Component A (Resin) (2.87kg)
Component B (Hardener) (0.63kg)

- a. The system so devised should follow the antistatic specifications of ASTM D257 (Surface Resistivity) or BS 2050 (electrical Resistance) The static decay Test should be around 0.02sec. the manufacturer should have Test Reports from some prestigious institutions like Central Power Research Institute or ERTL.

APPLICATION LAYING PROCEDURE

The concrete should be properly cleaned and must be free from oil, grease, cement laitance, dust and other surface contaminants. The moisture content of the concrete must be checked and if found higher than 4% the concrete should be subjected to blow lamps, etc. to reduce the moisture contents.

Grooves of size 2mmX2mm at the edges of room along the perimeter and across the room are to be cut .

A copper wire of approx 3/20 gauges is to be laid in the groove in a slight tension manner with help of U nails. After lying of Copper wire the entire groove is to be filled with antistatic Epoxy putty comprising of Part A, Part B and Part C.

After fixing the wire and putty apply antistatic Primer @250gms per sqm with component A and B in ratio as mentioned above.

Allow the primer to dry and when it is tack free Mix component A & B & C of screed AS Basecoat and apply on the surface @2.0kg per sqm for approximately a thickness of 1mm.

After this application allow the Basecoat to dry for 24 hrs and then apply the top coat of self leveling SCREED AS on top of the Basecoat after mixing component A & B. The Application of Top coat has to be either in single layer or double layer @ 3.5kg per sqm to give overall thickness of the self leveling Antistatic screed as 3mm. After spreading of

screed spread the material with notch trowel and spike the entire surface with specially designed Spike rollers to remove any air bubbles entrapped within the screed .

After the entire Self Leveling screed has been trowel and spiked allows it dry and cure. For soft Foot traffic movement curing of a minimum of 48hrs is recommended and for other regular use of the area a minimum of 7 days of curing is advisable.

14.0 HORTICULTURE WORKS:

14.1 GRASSING

14.1.1 PREPARATION

During period prior to planting the ground shall be maintained free from weeds.

Grading and final nevenne of the lawn shall be completed at least three weeks prior to the actual sowing. Clods of excavated earth shall then be broken upto the size not more than 75mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds that re-germinate shall be uprooted carefully. The rubbish arising from this operation shall be removed and disposed of in a manner directed by Engineer. Regular watering shall be continued until sowing by dividing the lawn area into portion or approx 5 mts. Square by constructing small bunds to retain water. These 'bund's shall be nevenn just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that he soil has completely settled.

Slight nevenness, ups and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the final levels by adding suitable quantities of good earth brought from outside, if necessary as directed by the Engineer. In fine dressing, the soil at the surface and for 40mm depth below shall be broken down to particles of size not exceeding 6mm in any direction.

14.1.2 SOIL :

The soil itself shall be ensured to satisfaction of Engineer to be a good, fibrous loam, rich in humus.

14.1.3 SOWING THE GRASS ROOTS :

Grass roots (Cynodon dactylon or a local approved by the Engineer) shall be obtained from a grass patch, seen and approved before hand.

The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.

Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

14.1.4 EXECUTION :

Small roots shall be debbled about 15 cms (or at other spacings as per BOQ item)apart into the prepared grounds. Dead grass and weeds shall not be planted.

Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

All planting is to be done in moderately dry to moist (not wet) soil and at times when wind does not exceed a velocity of 8 kilometer per hours.

14.1.5 MAINTENANCE OF LAWN

As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level of the first two or three cuttings. That is to day the grass should be cut so that it is from 1 to 2 inches in length, instead of the $\frac{1}{2}$ to $\frac{3}{4}$ of an inch necessary for mature grass.

In absence of rain the lawn shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.

Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the contractor.

Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the contractor's expense.

The contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

14.1.6 ROLING :

A light roller shall be used periodically, taking care that the lawn is not too wet and sodden. Rolling should not be resorted to, to correct the levels in case certain depressions are formed due to watering

14.1.7 EDGING :

The contractor shall establish a neat edge where planting areas meet grass areas with spade or edging tool immediately after all planting, including lawn planting, is completed. Particular care shall be exercised in edging to establish good flowing curves as shown on the plans or as directed by the Engineer. Edging must be cut regularly and shall be maintained by the contractor.

14.1.8 FERTILIZING :

The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres of water.

14.1.9 WATERING:

Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least upto a depth of 20 cms to eliminate air pockets and settle the soil. To reduce the landscape/horticulture water requirement sprinkler type garden hydrant shall be installed as per drawings/BOQ item. The treated STP/ETP water may be used for horticulture wherever it is feasible.

14.1.10 WEEDING:

Prior to regular mowing the contractor shall carefully remove rank and unsightly weeds.

MAINTENANCE

The landscape contractor shall maintain all planted area within the landscape contract boundaries until the period of one year after the complete plantation. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other disease by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape sub-contract area neat in appearance.

PRUNING & REPAIRS

Upon completion of planting work on the landscape sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees. In general, one third to one fourth branching structure of the plants to be removed to compensate the loss of roots during transplantation by thinning or shortening branches but no leaders shall be cut. All pruning shall be done with sharp tools in accordance with instructions of the consultant. Pruning cuts shall be painted with recommended paints.

TREE GUARDS :

Where tree guards are necessary, care should be taken to ensure that they do not impede movement or restrict growth.

NURSERY STOCK :

Planting should be carried out as soon possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be heeled in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labeled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

PROTECTIVE FENCING :

According to local environment shrubs may have to be protected adequately from vandalism until established.

TECHNICAL SPECIFICATIONS

1.00 GENERAL SCOPE OF WORK

The scope of work shall cover internal and external electrical works for **CONSTRUCTION OF 100 BEDDED HOSPITAL CHATTISGARAH, UNDER NATIONAL RURAL HEALTH MISSION SCHEME**. The scope of work covers major electrical equipments as per BOQ. Also, supply, installation, testing and commissioning of electrical works of the project including the following main items/systems:

- i. H.T. Sub-station including VCB panel, Transformers, bus ducts, HT cables etc
- ii. Main LT , Capacitor panels (APFC), Rising mains, MV Panels.
- iii. DG sets including AMF panels / Synchronizing panel etc.
- iv. MCB Distribution Boards.
- v. Internal electrification through concealed MS conduit and provide light points, fan points, socket outlets etc. including supplying, installation, testing and commissioning of light fixtures, fans etc.
- vi. Conduiting and wiring for telephone points including Main Telephone Distribution Boards (Tag Blocks), telephone outlets etc. complete with telephone cabling from tag blocks to telephone outlets including EPABX, telephone instruments etc..
- vii. Addressable Fire Detection & Alarm System consisting of Main Fire Control & Indicator Panel, Smoke & Heat Detectors, Manual Call Points Hooter etc. including conduiting/wiring & cabling complete.
- viii. Conduiting for computer networking
- x Lightning protection system consisting of lightning arrestor, finial, horizontal and vertical strips, test joints, earth electrodes etc.
- xi. Lifts
- xii LT Cabling.
- xiii Earthing, safety equipments and misc items required for electrical installation complete in all respect.
- xiv Out door lighting
- xv Testing and commissioning of all electrical installations

- xvi Any other items/ works required for the completion of electrical works.
- xvii Enhancement/Sanctioning Electrical Load from State Electricity Board.
- xviii Submission of GA drawings of electrical equipments and getting approvals from Client/ Owner before manufacturing/fabrication.
- xix Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority, Telecom Department, and any other statutory authorities for the complete scope.
- xx contractor shall submit equipment drawing from manufacturer along with the layout etc. and working drawings for approval from HSCC Electrical Engineer before manufacture / commencement of work at site.
- xxi Contractor has to submit the working drawing of internal electrification based on our tender drawings for the approval of HSCC Electrical Engineer before commencement of work.
- xxii Contractor has to take the approval of DB schedule/drawing of each DB from HSCC.
- xxiii Incase, details of any electrical item/ system are left out, then kindly refer the CPWD specifications & approval from Engineer.

2.0 REGULATIONS AND STANDARDS

2.1 **All equipments their installation, testing and commissioning shall conform latest CPWD/ IS specifications in all respects.** Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian electricity Rules and the Regulations, National Electric Code, National Building Code, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall conform to the Indian Standards specifications and code. Mode of all measurement will be as per latest CPWD norms/ specifications Some of the applicable codes/standards are as under:

- | | | |
|----|---|------------------------------------|
| a) | CPWD General specifications for electrical works | Part-I (Internal)- 2005 |
| b) | CPWD General specifications for electrical works | Part-II (External)-1995 |
| c) | CPWD General specifications for electrical works | Part-III (Lifts & Escalators)-2003 |
| d) | CPWD General specifications for electrical works | Part-IV (Substation)-2007 |
| e) | CPWD General specifications for electrical works | Part VII (DG Sets) 2006 |
| f) | CPWD Specification/norms for measurement | Latest revision |
| g) | Guide for marking of insulated conductors | IS 5578 |
| h) | Guide for uniform system of marking and identification of conductor and apparatus terminals. | IS 11353 |
| i) | Low voltage switchgear and control gear assemblies | S 8623 Part-1 to 3 |
| j) | Specification for low voltage switchgear and control gear | IS 13947 |
| k) | Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC | IS 2675 |
| l) | Code of practice for selection, Installation and maintenance of switchgear and control gear. | ISI 10118 Part – 1 - 4 |
| m) | Low-voltage fuses for voltages not exceeding 1000V AC or 1500V DC | ISI13703 Part-1&2 |
| n) | PVC insulated (heavy duty) electric cables | IS 1554 |

o)	PVC insulated cables for working voltages upto and including 1100V.	IS 694
p)	Conduit for electrical installations	IS 9537
q)	Accessories for rigid steel conduits for electrical wiring	IS 3837
r)	Boxes for the enclosure of electrical accessories	IS 14772
s)	General and safety requirements for luminaries	IS 1913
t)	Code of practice for earthing	IS 3043
u)	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
v)	Low voltage switchgear and control gear	IS 13947 part 1 – 5
w)	Residual current operated circuit breakers	IS 12640
x)	Current Transformers	IS 2705
y)	Voltage Transformers	IS 3156
z)	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
A1)	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages upto and including 1000V ac and 1200V DC.	IS 13947 & IS 1336
B1)	ONAN Transformer	IS 11171

In case of contradiction in specification the priority of the documents shall be as follows:

CPWD/ IS specification, BOQ, drawings, Technical specifications.

3.0 H.T. SUBSTATION

3.1 11 KV VACUUM CIRCUIT BREAKER PANEL BOARD

3.1.1 GENERAL:

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB's shall conform to IEC 298 and 694 IS 3427, BS 5227 and VDE 0670, part 6 as well as the regulations mentioned therein. VCB's shall be suitable for operation on 11kV, 3 phase, 50Hz, AC supply.

3.1.2 TYPE AND CONSTRUCTION:

The metal clad panel shall be fully extensible and compartmentalized to give.

- a. Circuit Breaker Compartment
- b. Busbar Compartment
- c. CT and Cable Compartment

3.1.2.1 The compartments shall be safe to touch and compartments thus formed shall be dust proof & vermin proof. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be provided panel on the front.

3.1.2.2. The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminum oxide. The contacts shall be of chromium copper and butt shaped.

3.1.2.3 Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The draw out carriage shall have two positions for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy monobloc designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

3.1.2.4 It shall be horizontal isolation, horizontal draw out type, fully interlocked, with dust and vermin proof construction, suitable for indoor installation. The panel shall be supplied with the manufacturer's test certificates.

3.1.2.5 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric

acid and recognized phosphate process and shall then be given power coating (Electrostatic) paint of manufacturer's standard shade.

3.1.2.6 The switchgear constructions shall be such that breaker operation and internal explosions do not endanger the operating personnel, 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.

3.1.2.7 Voltage transformer of burden not less than 100va and of proper ratio as specified

shall be provided . the accuracy class for the vt shall be 0.5 as per is 3156 part 1 to III for incomer and class I for outgoing panels. The PT shall be of cast epoxy resin construction . It shall be fixed/withdraw able type. HRC fuses cb shall be provided on both HV and Lv side. Adequate space at the rear of the panel shall be provided for the termination of power & control cables. The panel shall be provided with suitable terminating arrangement for the termination of cables .Burden of pt should match with the requirement of client.

3.1.2.8 The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the busbars & cable compartment for the fixed contacts.

3.1.2.9 Safety shutters shall be provided to cover up the fixed high voltage contacts on busbar 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 busbars side and cable side individually.

3.1.2.10 Mechanically operated circuit breaker auxiliary switches of minimum 5 NO + 5 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by 1.5 sq. mm; 1.1kV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

3.1.2.11 Terminal blocks 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 1.5kV for one minute.

3.1.2.12 Busbar compartment shall be provided at the rear. Electrolytic copper busbars shall be of rectangular cross section and insulated. Busbars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Busbars shall be provided with necessary color coding for

phases indication. The busbars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 45 deg. C.

3.1.3 BUSBAR AND REGULATORS

3.1.3.1 All busbars and jumper connections shall be of 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. Busbar cross section shall be uniform throughout the length of switch board.

3.1.3.2 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.

3.1.3.3 Busbar insulators shall be of track-resistance, high strength, and non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the busbars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

3.1.4 EARTHING AND PROTECTIVE EARTHING

3.1.4.1 Copper earthing bus shall be provided. It shall be bolted/ welded to the framework 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. 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 busbars & feeder circuit. Earthing rod consisting of 16 Sq.mm. stranded/flexible copper cable 15 Mtr. long and connectors shall be supplied. Cost of this earthing rod is deemed to be included in the cost of VCB Panel.

3.1.5 METERING AND PROTECTION

3.1.5.1 The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The protection c.ts shall be of accuracy class 5 p 10 of 2705- part -III- 1992,the metering cts shall conform to the metering ratio and accuracy class 0.5 of is 2705-1992 for the incomer and class I for the outgoing panels.Ammeter and voltmeter to be installed on panel shall be digital type. Voltmeter transformer of burden not less than 100va shall be 0.5 as per IS 3156 partI to part III for incomer and class I for outgoing panels.The PT shall be fixed /withdraw able type. HRC fuses/ MCB shall be provided on both hv and lv side. All meters shall be 96mm squire pattern ,flush mounting type necessary selector switches. Necessary lamps of low voltage type with built in resistors shall be provided 9maximum wattage 2.5w0. Burden of Ct should match with the requirement of the client.

3.1.6 OPERATING MECHANISM

3.1.6.1 Vacuum Circuit Breaker shall be equipped with motorized spring charge. 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.

3.1.6.2 Interlocking and Safety Arrangement

3.1.6.3 Vacuum Circuit Breaker shall be provided with the following safety and interlocking arrangements:

- i. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is 'On'.
- ii. The circuit breaker cannot be switched 'ON' when the carriage is in any position between test & service position.
- iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.
- iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.
- v. The door cannot be closed unless the LV plug has been fitted.
- vi. 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.
- vii. Individual explosion vents shall be provided for breaker, busbar, 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.
- viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.
- ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

3.1.7 Rating:

3.1.7.1 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 350 MVA (18.37 KA RMS) at 11 kV. The rated making capacity shall be as per the relevant standards.

3.1.8 Accessories:

3.1.8.1 Circuit Breakers shall be provided with the following accessories.

- i. Auxiliary Switch with minimum 5 NO+ 5 NC auxiliary contacts.
- ii. Tripping Coil
- iii. Mechanical Operation Counter
- iv. Spring Charging Handle

3.1.9 Additional Accessories

3.1.9.1 The loose items to be supplied with the 11kV VCB Panel Board shall comprise of the following:

- a. Instruction Book.
- b. Maintenance Manual.
- c. Reaching in/out handle.
- d. Handle for spring charging mechanism.
- e. Foundation bolts.
- f. Busbar Earthing & Circuit Earthing Trolley.

3.1.10 Mounting

3.1.10.1 Vacuum Circuit Breakers shall be mounted as per manufacturer's standard practice.

3.1.11 Auxiliary Supply

- a. The tripping shall be at 24 Volt D.C. through a power pack unit.
- b. Space heater indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangements complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the purchaser's cable.

3.1.12 TESTS

3.1.12.1 Factory Tests

The circuit breakers panel shall be subjected to routine tests at manufacturer's works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

- a. Power frequency voltage test on the main power circuit.
- b. Verification of the correct wiring/Functional Test.
- c. Dielectric test at 1.5kV on the control circuit. Apart from above, the vendor shall submit the routine test certificates for the following equipment.

- i. Circuit Breakers
 - ii. Current Transformers
 - iii. Voltage Transformers
- 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.

3.1.13 Site Test

3.1.13.1 General

1. Verification for completion of equipment, physical damage/deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar 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.

3.1.13.2 Circuit Breaker & Panel

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
2. Manual/Electrical operations of the breaker and Functional test as per drawings.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28kV RMS). At site Hi Pot test is carried out at 80% of 28kV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

3.2 HT CABLES

3.2.1 Construction

All H.T cables shall be of 11kv grade XLPE earthed insulated & PVC sheathed flat steel wires (strips) armored electrical purity aluminum conductor cables shall be manufactured & tested in accordance with IS Specification.

3.2.2 TERMINATION JOINTS

Terminal joints shall be carried out as per IS specifications. Heat shrink cable termination kit shall be used for terminations.

3.2.3 INSTALLATION OF CABLES

Cable laying shall be carried out as per CPWD specifications.

3.4 CABLE TRAY

Cable tray is manufactured at Indian Standard Specification. Laying is done as per IS & cpwd specification.

3.5 EARTHING

Earthing specified in BOQ is done as per IS & CPWD specification.

4.0 MAIN DISTRIBUTION BOARDS AND SUB DISTRIBUTION BOARDS/ PANELS

4.1 GENERAL

Main/Sub Distribution Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system.

4.2 CONSTRUCTION

Main/Sub Panels shall be:

- i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.
- ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
- iii. Provide dust and damp protection.
- iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.
- v. All panels shall be front access type.

Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of the following:

- i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2 mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 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. A cable chamber housing 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. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.
- iv. Front and rear doors fitted with dust excluding 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.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350mm.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) 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/Sub Panels shall have the following minimum clearances.

- i. Between phases - 32 mm
- ii. Between phases and neutral - 26 mm
- iii. Between phases and earth - 26 mm
- iv. Between neutral and earth - 26 mm

When, 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 with 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.

Functional units such as circuit breakers and moulded case circuit breakers 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 busbars 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.

4.3 METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub 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.
- vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.
- vii. Paint shade shall be Pebble (light) grey, shade no RAL 7032 unless otherwise specified.

4.4 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 25kA RMS symmetrical for one second. 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 busbars. Large clearances and Creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Capacity of aluminum busbars shall be considered as 0.8 Amp per sqmm. of cross sectional area of the busbar. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars 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. Busbars to be colour coded with PVC sleeves.

4.5 SWITCHGEARS

Refer subhead 5.00 – LT switchgears

4.6 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. A cable chamber 150 mm. high shall be provided at the bottom through out the length and depth of the MDB/SDB. 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.

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.

4.7 LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

4.8 TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

4.9 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: As per CPWD Specifications.
- d) Trip tests & protection gear test.

5.00 L.T. SWITCHGEARS

5.01 AIR CIRCUIT BREAKERS

5.01.1 GENERAL

Air circuit breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

5.01.2 Technical Specifications:

The Air circuit breakers shall conform to the requirements of IS13947-2 and IEC 60947-2 & their latest amendments and should be type tested & certified for compliance to Indian standards from CPRI/ERDA. Manufacturer shall submit test report for combined sequence tests from CPRI/ERDA. The breakers shall be suitable for isolation and should be clearly indicated on the front facia. The Air circuit breakers shall be suitable for following system conditions:

- 1) The ACBs shall have $I_{cs} = I_{cu} = I_{cw}$ for 1 sec for short circuit breaking capacity of not less than 50 KA rms at 415 Volts 50Hz ac.
- 2) Rated Operational Voltage (V) & Frequency : 415 Volts, 3 phase, 4wire 50 Hz.
- 3) Rated insulation voltage (U_i): 1000 volts AC
- 4) Ambient temperature: designed at 40 degree C ambient temperature. ACB shall be fully rated at inside panel temperature of 50 deg C.
- 5) Rated impulse voltage 8 KV for Main circuit.
- 7) Utilization Category: B

All ACBs shall be of electrically operated and draw out type (EDO) unless otherwise stated. The circuit breakers shall be 3/4 pole (as specified in BOQ) with quick make/break, trip free operating mechanism.

All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided to protect the main contacts.

The ACBs shall be fitted with detachable arc chutes on each pole designed to permit rapid dispersion, cooling and extinction of the arc. It should be possible to remove arc chutes without using any tool & without removing the breaker from the panel.

The ACBs shall have minimum mechanical life of 20000 operations for ratings up to 2500A & 5000 operations for higher ratings. It should be possible to extend electrical life of the ACB to mechanical life by replacing the arcing contacts at site.

It shall be possible to directly terminate Aluminum links / bus bars as specified in IS13947-2. All 4 Pole ACBs should have fully neutral Pole.

Auxiliary switches directly operated by the breaker operating mechanism and having 6NO and 6NC contacts, shall be provided on each breaker. The auxiliary switch contacts shall have a minimum rated thermal current of 10 Amps at 230V ac.

All the ACB ratings shall have a uniform panel door cut-out, on left or right side of the panel for allowing maximum utilization of panel space. The ACB with Panel should meet IP53 protection on breaker front.

Cradle:

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. Draw out ACBs shall have 4 distinct and separate positions wrt cradle ie Service Position, Test Position, Isolated Position and Maintenance. ACB should have facilities for carrying out maintenance without physically removing the breaker from panels.

For ease of maintenance, it should be possible to replace jaw contacts without disturbing the busbar links for draw-out type ACBs.

Protection Release

The protection release of **Incomer level ACBs (except APFC Panels)** should be microprocessor based release having inbuilt adjustable protections against overload, short circuit, instantaneous and earth fault protection with adjustable time delay settings for all protections except instantaneous zone. The release should have separate indication by LEDs for Power ON, Overload, Short Circuit, Instantaneous and Earth Fault, Trip & Alarm. The release should provide following additional protection with necessary modules apart from basic protections:

- Undercurrent
- Current Unbalance
- Reverse power
- Under and over voltage
- Under and over frequency
- Phase sequence

- Maximum demand exceed

The parameterization should be possible through communication and menu. The release must provide a password protection to access the protection configurations. The release shall meet the EMI / EMC requirements.

The release should have high resolution LCD for comprehensive metering with the following parameters:

- Phase and Neutral currents (running, avg & max), percentage loading etc
- Phase voltages (P-P & P-N) (running, avg & max)
- Energy & power parameters (active, reactive and apparent)
- Maximum demand in KW
- Power Factor
- System Frequency
- Harmonic- Voltage & current

The release should be able to communicate on MODBUS RTU protocol using inbuilt RS485 port.

The release of **APFC Panels incomer ACB and Outgoing ACBs** shall be microprocessor based with following inbuilt protections and features :

- Protection against Overload, Short circuit, Instantaneous & Earth faults
- Short circuit & Earth fault protection zones shall have time based selectivity
- Self-diagnostic to indicate healthiness of microprocessor.
- Individual fault annunciation by LEDs without using external power supply
- On line change of settings shall be possible
- It should be possible to carry out On Line testing of release without tripping the ACB
- Switch selectable thermal memory to reduce thermal stresses
- The release shall trip the breaker directly
- Shall sense true RMS value of current
- The release shall be self powered and draw its power from the main breaker CTs and shall require no external power supply for its operation.
- The release shall meet the EMI / EMC requirements.

Safety Features:

Draw out ACBs shall be provided with automatically operated safety shutters to prevent accidental contact with live contacts when breaker is withdrawn from the Cradle.

For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle. It shall not be possible to interchange two circuit breakers of different thermal ratings.

Draw out breakers should not close unless in distinct Service/Test/Isolated positions.

Electrically operated ACBs shall be provided with mechanical anti-pumping.

Remote tripping device (Shunt release) should be able to trip the ACB, even at voltages as low as 10%.

The insulation material used shall conform to Glow wire test as per IEC60695.

It should be possible to access racking handle & carry out setting of the release from the front & without opening the cassette door.

5.01.2 TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically drawout type unless otherwise specified) with horizontal drawout carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Interphase barriers shall be provided to prevent flashover between phases.

5.01.3 OPERATING MECHANISM.

Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The

operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

5.01.4 INTERLOCKING AND SAFETY ARRANGEMENT

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

- i. It shall not be possible for breaker to be withdrawn when in "ON" position.
- ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.
- iii. The breaker shall be capable of being racked into 'testing', 'isolated' and 'maintenance' positions and kept locked in any of these positions.
- iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.
- v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

5.01.05 RATING

The rating of the circuit breaker shall be as per the drawings and schedule of quantities. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard.

5.01.06 ACCESSORIES

The breaker shall be equipped with electronic microprocessor based release to provide over current & earth fault protection. The breaker shall be fitted with following accessories for control, signal and interlocking.

- i. Auxillary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.
- ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.
- iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.
 - a. Kit for test/isolated indication.
 - b. Kit for service position indication.
 - c. Kit for shutter assembly.
- iv. Accessories for following interlocking schemes shall be provided.
 - a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.
 - b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.
 - c. Lockable trip push button.

5.01.07 MOUNTING

Circuit Breakers shall be mounted as per manufacturers' standard practice.

5.01.08 TESTING

Testing of each circuit breaker shall be carried out at the works as per IS 2516 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.

5.02 MOULDED CASE CIRCUIT BREAKERS.

5.02.01 GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from $0.4I_n$ to $1.0 I_n$.

5.02.02 Technical Specifications

The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. The MCCB should be either 3 or 4 poles as specified in BOQ.

MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA

MCCB shall comprise of Quick Make -break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The breaking capacity of MCCB shall be minimum 35KA / 50 KA or as specified in BOQ. The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}$).

All MCCBs upto 200A ratings should be provided with Thermal Magnetic type release with adjustable Overload and fixed short circuit protections. MCCBs of ratings 250A & above shall be provided with Microprocessor based having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics conforming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts.

5.02.02 FRAME SIZES

The MCCBs shall have the following frame sizes subject to meeting the fault level.

- a. Upto 100A rating 100A frame.
- b. Above 100A upto 200A 200A frame.
- c. Above 200A up to 250A 250A frame.
- d. Above 250A up to 400A 400A frame.
- e. Above 400A up to 630Aq 630A frame.
- f. Above 630A to 800A 800A frame.

5.02.03 CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBS shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

5.02.04 BREAKING CAPACITY

Unless otherwise specified, rated service breaking capacity of the Moulded Case Circuit Breakers shall be minimum 25kA.

5.02.05 TESTING

- a. Original test certificate of the MCCB as per Indian Standards (IS) 315-C-8370 shall be furnished.
- b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

5.03 SWITCH DISCONNECTOR FUSE UNITS

The Switch Disconnecter Fuse Units shall be double break type suitable for load break duty (AC 23) quick make and break action. Hinged doors shall be duly interlocked with operating mechanism so as to prevent opening of the door when the switch is in 'ON' position and also prevent closing of the switch when the door is not properly secured. All contacts incoming and outgoing terminals of switch shall be adequately sized to receive proper size of cables. High rupturing capacity (HRC) fuse links shall be provided with switch fuse units and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. HRC fuse links shall be provided with visible indicators to so that they have operated. The switch disconnecter fuse units shall be manufactured in accordance with IS 13947-3-1993.

FUSE

Fuse shall be of the high rupturing capacity (HRC) fuses links and shall be in accordance with IS 13703-1&2-1993 and having rupturing capacity of not less than 31 MVA at 415 volts. The backup fuse rating for each motor/equipment shall be chosen as the fuse does not operate on starting of motors/equipments.

5.04 MEASURING INSTRUMENTS, METERING & PROTECTION

5.04.01 GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of 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 suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular 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 instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within 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 work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

5.04.02 Digital AMMETERS

Ammeters shall be standard digital type or specified in BOQ the ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

5.04.03 Digital VOLTMETERS

Voltmeters shall be standard digital type or specified in BOQ the ammeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

5.04.04 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 acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1

Protection : Class 5P10.

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 transformers 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.

All Current Transformer shall be Cast resin type.

5.05 MISCELLANEOUS

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 filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

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.

6.00 INTERNAL ELECTRIFICATION OF BUILDING

6.1 SCOPE

As specified in subhead 1.00

6.2 GENERAL

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications with up to date amendment.

- Specifications for Electrical Works Part-I (Internal) by CPWD – 2005 or latest revision
- Specifications for Electrical Works Part-II (External) by CPWD – 1994 or latest revision

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

6.3 DISTRIBUTION BOARDS.

As a general practice only pre-wired MCB type double door DB shall be used. Pre-wired DB shall have following features:

- i) Recess/ surface type with integral loose wire box.
- ii) Phase/neutral/ earth terminal blocks for termination of incoming & outgoing wires.
- iii) DIN channel for mounting MCBs.
- iv) Arrangement for mounting incomer MCB/RCCB/RCBO/MCCB as required.
- v) Copper bus bar.
- vi) Earthing terminals.
- vii) Wiring from MCBs to terminal block.
- viii) Interconnection between terminal block/ incoming switch/ bus bar/ neutral/ terminal block/ earth terminal connector with specified size of FRLS pre insulated copper conductor cable duly fitted with copper lugs/ thimbles.
- ix) Termination block should be suitable for termination of conductor/ cable of required size but minimum rated cross section of the terminal blocks should be 6 sq. mm.
- x) Terminal block shall be made of flame retardant polyimide material.

- xi) Coloured terminal blocks and FRLS wires for easy identification of RYB phases, Neutral and Earth.
- xii) Pre-wired DB shall be provided with a detachable cassette for safe removal of MCBs, RCCBs. Terminal connectors from the DB without loosening the internal cable connections of phase and neutral circuits.
- xiii) The pre-wired DB shall have peel able poly layer on the cover for protection from cement, plaster, paints etc during the construction period.
- xiv) Detachable plate with knock out holes shall be provided at the top/ bottom of board. Complete board shall be factory fabricated and pre-wired in factory, ready for installation at site. The box and cover shall be fabricated from 1.6 mm sheet steel, properly pretreated, phosphotized with powder coated finish.
- xv) DB shall be of double door construction provided with hinged cover in the front.

Distribution Board shall be standard type. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of 9 KA rated rupturing capacity unless otherwise specified.

Neutral busbars 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. 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. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker shall be current operated type and of 30mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn't have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

DETAILED SPECIFICATIONS

SYSTEM DESIGN DATA

1.0 General

The system design, basis of design, estimated requirements and other relevant data are outlined in this section. The specifications and specific requirements are outlined in the subsequent sections.

2.0 Location

Proposed '100/50 Bed hospital' located at Various Districts of Chhattisgarh(CG).

3.0 Scope of work

The work proposed under this tender includes Supply, Installation, testing & commissioning of Air Cooled package type DX units, Packaged, High Wall Split, Windows type and Ductable Split type Air-conditioning system and ventilation fans for the Hospital Block.

4.0 Basis of design

4.1 Assumptions

Following assumptions have been made for calculation of air conditioning cooling load of the building Areas.

- i. All exposed roof of A/C areas will be thermally insulated with 50 mm thick expanded polystyrene or equivalent insulation.
- ii. Construction of walls will be:

External walls	:	9 inch thick brick masonry, plastered inside and outside.
Internal walls	:	4.5 inch thick brick masonry, plastered inside and outside.
- iii. Glazing : Single pane transparent glass 1/4 inch thick

- iv. Lighting load : 2W/ sq.ft
- v Fresh air : - 2 Air changes per hour
- For OT's Air Cooled Package type DX unit with 5 ACPH fresh air.
- vi Occupancy : App.60- 100 Sq.ft per person or as per actuals.
- vii Equipment Load : As per standards
- viii Electrical power supply: 415V/3 Ph/ 50 Hz, AC power supply
- ix Humidity Control : Pan type Humidifier is considered only for OTs.
- x Winter Heating: : Winter heating have been considered in Package type DX units for OT areas and critical areas.

4.2 Outside Ambient conditions

Season	Dry Bulb temp (deg. F)	Wet Bulb temp. (deg.F)
Summer	110	75
Monsoon	95	83
Winter	45	41

- 4.3 Inside Conditions** For OT's : 72+/-2 deg F , 50-60% RH
Other areas and buildings: 75+/-2 deg F DB, 50-60% RH

5.0 System Design

- 5.1 To meet the air conditioned load during summer & monsoon, it is proposed to provide Window, Split and Ductable Split Type Air Conditioner. The Air cooled package type DX AHUs are considered for OT's air-conditioning.
- 5.2.1 Conditioned air shall be taken from the ductable split type air conditioner through GI/Aluminium ducting and supplied to conditioned areas through ceiling / wall mounted grilles / diffusers. Return / exhaust air shall be collected through similar grilles and diffusers and returned to ductable split AC through false ceiling /return air duct.

OPERATION THEATRES

- Operation theatres shall have independent air handling unit to prevent cross contamination.
- OT's shall be designed for recirculatory system with 5 air changes fresh air.
- The laminar flow air distribution system shall be followed. Air shall be supplied from ceiling level to flow uni directionally up to the operation table. The return air shall be collected from four corners of the room to prevent the contamination from recirculation in space.
- All ducting for OTs shall be of aluminium because GI duct can cause formation of flakes on contacting moisture that can be carried down stream.
- Both supply and return air shall be ducted.
- Three level filtration shall be adopted with pre-filters, fine filters and HEPA filters of following filtration efficiency :

Hepa Filters 99.97% down to 0.3 μ

Fine Filters 99% down to 5 μ

Pre Filters 90% down to 10 μ

All these filters shall be with aluminium frame to prevent formation of bacterial colonies. Epoxy resin shall be used to seal filter media with the framework.

OTs shall be maintained at positive pressure by supplying about 15% more air than return air to prevent any contamination from entering OT space.

AHUs with HEPA filters shall be designed for high static pressure to over come high pressure drops

- 6.0 For fire safety fire dampers shall be provided in supply and return air ducts. All materials used for insulation shall be fire proof type. The split air conditioner & duct mounted inline fan motors shall also be interlocked with the central fire alarm system of the building such that in case of detection of smoke or fire by the fire alarm system, the units shall automatically shut off.

7.0 Items to be provided by other Agencies free of cost to AC contractor

- 7.1 Civil works such as trenches for piping, cables and making foundations of equipment etc.
- 7.2 Main 3 ph, 415 v, 50 hz, A.C. supply power supply up to each panel of Ductable Split AC.
- 7.3 Main 1 ph, 220 v, 50 hz, A.C. supply power supply within 1 metre for Window & Split AC.
- 7.4 Any kind of false ceiling, boxing.

7.5 Making frames for fixing grilles & diffusers in false ceiling, boxing or in walls.

8.0 Drawings

The drawings forming part of these specifications provide a feasible scheme for locating the equipment and it is for the reference purpose only. The contractor may re-arrange the equipment for improving the layout and meeting the site conditions. All such changes shall however be subject to the architect's approval. These drawings are not meant to be working drawings which shall be prepared by the contractor as required.

9.0 Test Data

The complete HVAC system shall be tested as per the specifications given elsewhere and complete test data shall be furnished on prescribed data sheets:

10.0 Technical Data

The contractor shall furnish complete technical data, on the equipment offered as required under the heading 'Technical data'

11.0 Performance Guarantee

11.1 The contractor shall guarantee that the air conditioning plant shall maintain the desired inside temperature within +/- 2 % tolerance for the rooms supplied with Package AC.

11.2 The contractor shall guarantee that the capacity of various components as well as the whole system shall not be less than specified.

11.3 The contractor shall ensure that the system shall be free of vibrations and disturbing sounds.

Air cooled Package Type DX Units

1. Scope:

The section sets out the general requirements for factory built or assembled Air cooled condenser type Package DX Units complete with safety controls, instruments electrical installation including installation testing and commissioning

2. Components of Machines

Each Air cooled Package DX unit shall be complete with hermetic type compressor/s, Indoor Unit, Outdoor Unit, compressor motor, interconnecting refrigerant piping of required size from indoor to outdoor unit with necessary valves, strainers ,thermal insulation etc, refrigerant controls and accessories, gauge panel, motor starters, and electrical controls, safety controls and devices and first charge of refrigerant, oil etc.

3. Compressor

Compressor shall be multi cylinder semi hermetic/hermetic type complete with drive and motor, dynamically balanced removable cylinder sleeves, oil return check valves suction and oil strainers, discharge and suction shut-off valves, site glass etc .Compressor and motor assembly shall be installed on a spring mounted floating platform to provide quite vibration less operation. Compressor shall be provided with overload protection switches etc.

The compressor shall be enclosed in a hermetically sealed casing and shall be suitable for R-134a / R-410a.

4. Outdoor Unit (Air cooled Condenser)

The air cooled condenser coil shall be of heavy gauge suitable copper tubes with aluminium fins and condenser shall be so designed to give the required capacity for the specified peak ambient conditions. Suitable axial flow heavy duty condenser Fans for low speed quite operation shall be selected. The condenser Fan shall be suitable for 415 V/3Ph/AC supply. The casing shall be fabricated from galvanized steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit weather proof suitable for outdoor installation. The unit shall include a remote control assembly with thermostat and starting and speed switches. The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

5. Indoor Unit (Double skin Air Handling unit)

The Indoor Unit/air handling units shall be double skin fully enclosed construction, draw-thru type and shall include flat filter section, fan section, coil section, Microvee /HEPA Filter section, and humidifier section etc with necessary vapour arrangement. The AHU shall be two tier type with the Microvee and HEPA

filter sections in the upper tier.

5.1 Fan Section

Fan shall be centrifugal with forward or backward inclined blades. Fan casing shall be made of galvanised steel sheet. Fan wheels shall be made of galvanised steel. Fan shaft shall be ground C40 carbon steel and supported in pre-greased ball bearings operating less than 75% of first critical speed. Fan wheels and pulleys shall be individually tested and precision balanced dynamically. The fan shall be selected for a fan speed not exceeding 1000 rpm for fan dia of more than 350 mm .The fan outlet shall be connected with casing with the help of fire retardant canvas.

5.2 Coil Section

The cooling coil shall be of seamless copper tubes, the internal and outer dia of the cooling coil shall be as per the standards of the approved makes with aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and such that the air velocity across the coil shall not exceed 500 FPM. The coil shall be pitched in the unit casing for proper drainage. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow.

The fins shall be uniformly bonded to the tubes by hydraulic mechanical expansion of the tubes. Fin spacing shall not exceed 5 fins per cm. The coiling coil assembly shall be on aluminium rails and nylon rollers for easy with drawl from either side.

5.3 Prefilters

Each unit shall be provided with a factory assembled filter sections containing washable synthetic type air filters. Filter framework shall be duly sealed and constructed from aluminium alloy. The media shall be supported with HDP mesh on one side and aluminium frame mesh on other side. Filters face velocity shall not exceed 500 FPM. Filters shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filters cells in bank. These cells shall be held within the frames by sliding the cells between guiding channels.

5.4 Humidifier Section

A separate humidifier section shall be provided in the AHU's in the lower tier. Pan humidifier shall be placed outside the AHU & within the AHU room & steam shall be supplied in the humidifier section.

5.5 Housing/ Casing

The housing /casing of the air handling unit shall be of double skin panels, sandwiched type with polyurethane foam insulation of 25 mm thickness (overall). The housing shall be so made that it can be delivered at site in the total/ semi knock down conditions depending upon the location. The frame work shall be of extruded aluminium hollow section duly powder coat painted/ anodized. All the frame shall be

assembled using mechanical joints to make a sturdy & strong frame work for various sections.

The outer sheet of panel shall be of made of galvanised pre-plasticised sheet/powder coated CRC sheet of 0.80 mm thickness, and inner sheet of 0.63 mm thick GSS. These panels shall be bolted from inside on the frame with soft rubber gasket in between to make the joints air tight.

Frame work for each section shall be bolted together with soft rubber gasket in between to make the joints air tight, suitable doors with chrome plated hinges and latches shall be provided for access to various panels for maintenance. The entire housing shall be mounted on steel channel frame work. Units shall have hinged, quick operating access door in the fan section etc. The access doors shall also be double skin type similar to the casing.

The special (Microvee and HEPA) filters shall be housed in a separate AHU upper tier casing of suitable size & length.

The enclosure shall be sized to accommodate the standard Microvee filter. The inspection doors shall have double synthetic rubber seals doors & locking arrangements. The gaps between filter frames & housing shall have synthetic rubber packing to eliminate any air leakage. All filter frames & metallic parts shall be made of Aluminium. The Microvee filter sections shall have provision for fixing a portable inclined manometer for taking filter pressure drop readings.

Drain pan shall be constructed of 18 gauge aluminium sheet with necessary slope to facilitate fast removal of condensate. It shall be isolated from the bottom floor panels through 12 mm thick kinny foam insulation or equivalent.

5.6 Fan Motor and Starter

The totally enclosed fan cooled squirrel cage fan motor shall have a minimum rating as given under "Schedule of Equipments and the starter rating shall match the motor rating and both control panel shall conform to the specifications under "Motors and Switchgears". Drive to fan shall be provided through belt-drive arrangement. Belts shall be of oil resistant type.

5.7 Controls

Each air handling unit shall be provided with a modulating valve motor and modulating thermostat, conforming to specifications under "Controls".

5.8 Accessories

Each indoor/air handling unit shall be complete with: -

Thermostats at coil inlet and outlet with display on microprocessor base control panel of the system.

Pressure gauges with cocks at inlet and outlet of the coil.

Drain line from unit to drain trap.

Flexible connection between fan outlet and duct.

Vibration isolators of high efficiency.

6.0 Refrigerant System

The air conditioning units shall be complete with pre-charged refrigerant line

including fittings, valves and thermostatic expansion valve. Automatic resetting type low and High Pressure cut outs shall be provided to safe guard the unit against abnormal operation.

7.0 Control, Instrumentation and Accessories

Each unit shall be equipped with but not restricted to the following

Crankcase heaters

High –low cut outs

Safe guard against short cycling of compressor

Insulated drain piping

Compressor and Fan motor starters with bi-mettalic overload relays with resting

Isolation valves for air cooled condensers in refrigerant lines

Expansion Valves

Vibration isolation Pads below the units

Double canvass connection b/w indoor unit and starting ducts

A snap acting type fixed differential double throw type air thermostat shall be provided to start and stop the compressor depending upon the air conditioned space requirements in addition to a manually operated switch. The thermostat shall be able to be adjusted from 18 0C to 260 0C with an increment of minimum 0.50C

All the moving parts in the units shall be mounted in the steel frame work with the help of suitable vibration isolators in order to ensure quite operation of the unit

8.0 Microvee filters (fine filters)

Microvee filters shall be of dry type. Filters media shall be made from washable nonwoven synthetic fibre replaceable media reinforced with HDPE cloth & Aluminum mesh, specially treated with antifungal and bactericidal agents to prevent growth of micro organisms. The filter media shall be treated to permit washing with water several times before discharged. The media shall be properly supported and spaced so that air flow through the filter is uniform. The filter shall be housed in aluminium frame work. Filters shall be designed to remove particle down to 5 micron size and with efficiently of 98.0 percent tested as per BS 2831 using Test Dust II. The filters shall be installed in the air handling units after the chilled water coils. They shall be capable of being replaced or removed for servicing without the use of special tools.

9.0 High Efficiency Particulate Absolute (HEPA) Filters

HEPA filters shall be made in extended surface configuration of deep space folds of sub micron glass fibers. The filter media shall be housed in an aluminium sheet frame provided with double turned flanges and closed cell neoprene gasket. The filter media shall not absorb moisture, stretch, swell or undergo chemical change with moisture. The filter shall be resistant to fungus and bacterial growth. Filters shall be free from pin holes and other leaks.

The housing shall be designed to install the HEPA filters in the terminal locations in the false ceiling or in the duct plenum so that it is removed easily without risking the

infiltration of dust whatsoever. The arrangement for filters shall be strictly in accordance with the manufacturers recommendations and shall be approved by the engineer prior to fabrication and installation. The filters shall be protected with aluminium slotted protective grille from the bottom in case of installation of filters in false ceiling air terminals. All MS parts shall be derusted and shall be epoxy painted. The aluminium grilles shall be made from 1.6 mm aluminium sheets with minimum clear area of 60 percent. The grilles shall be anodised stove enamel painted as approved by the Engineer.

10.0 Refrigerant Piping:

The indoor and outdoor unit shall be interconnected by a suitable type seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit.

Limitations:

The air velocity across the cooling coil shall not exceed 500 FPM.

The fan outlet velocity shall not exceed 1800 FPM.

The air velocity across the filters shall not exceed 500 fpm.

DUCTABLE SPLIT UNITS WITH AIR COOLED CONDENSERS

1.0 Scope

The scope of this section comprises the supply, installation, testing and commissioning of factory built self contained air cooled condenser type ductable split air conditioners complete in all respects and generally in conformity with these specifications, requirements of drawings Schedules of equipment and Bill of Quantities.

2.0 Components of Machines

Each ductable split air conditioners shall be complete with hermetic type compressor/s, DX type air cooled condenser, evaporator/ chiller, compressor motor, interconnecting refrigerant piping with valves and strainers etc. refrigerant controls and accessories, gauge panel, motor starters and electrical controls, safety controls and devices and first charge of refrigerant, oil etc.

3.0 Condensing Units

- 3.1 Each condensing units shall be complete unit with hermetic compressor/s, air cooled condenser, condenser fans with motors, internal piping , switches and internal wiring and shall be enclosed in a weather proof outdoor type housing.
- 3.2 The compressor shall be hermetic, with enclosed gas cooled motor. The compressors shall be suitable for R-134a / R-410a.
- 3.3 The condenser coil shall be air cooled type with aluminium fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 3/8" O.D.
- 3.4 The condenser air fans shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified out door conditions.
- 3.5 The casing shall be fabricated from galvanized steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit fully weather proof suitable for outdoor installation.
- 3.6 The unit shall include a remote control assembly with thermostat and starting and speed switches.
- 3.7 The necessary charge of refrigerant gas and lubricated oil shall be provided to run the system.

4.0 Ductable Cooling Unit:

- 4.1 The cooling unit shall be matched to the respective condensing unit and shall consist of cooling coil, blower, filters, outer casing, drain pan, accessories etc.

- 4.2 The cooling coil shall have copper tubes of not less than 3/8" o.d. and continuous aluminium plate fins with integral collars. The tubes shall be staggered in the direction of the air flow.
- 4.3 The fan section shall comprise of aluminium centrifugal blower/s, statically and dynamically balanced, motor, drive package, mounting arrangement etc.
- 4.4 The unit casing shall be made of galvanized steel, the casing shall be insulated to lower the noise level and eliminate condensation.

5.0 Refrigerant Piping

- 5.1 The condensing unit and evaporator unit shall be interconnected by type '1' seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit.
- 5.2 Valves used in the Refrigerant piping shall be of the packed, back seated type and shall be of forged /cast brass/bronze construction. All joints of steel to steel piping shall be welded and steel to Brass/Copper shall be silver brazed. Care shall be taken to remove the burr and dirt from the pipe ends and form proper 'V' at the mating ends before welding.
- 5.3 Flare type compression fittings shall be allowed upto 15mm piping diameter only for which annealed copper tubing shall be used.
- 5.4 Refrigerant piping shall be complete with the following accessories (but not limited to)
 - 5.4.1) Hot Gas line muffler.
 - 5.4.2) Liquid line strainer cum drier with disposable type of cover, with a bypass line with valve.
 - 5.4.3) Liquid line sight glass.
 - 5.4.4) Liquid Line solenoid valve.
 - 5.4.5) Thermostatic expansion valve.
 - 5.4.6) Liquid line Refrigerant Grade valves as required.
 - 5.4.7) Shut off valves on compressor.
- 5.5 Refrigerant Suction Gas to liquid heat exchanger, if provided, shall be tube in tube type fabricated out of M.S. heavy class seamless pipes conforming to IS 1239.
- 5.6 The suction line shall be insulated with 6mm rubber foam insulation.

6.0 Fresh Air Take Arrangement

An adjustable manual damper of M.S. sheet along with bird screen, air inlet louvers shall be provided for fresh air entry.

7.0 Miscellaneous

- 7.1 The unit shall have control panel, housing the starting switches, contactor, relays etc.
- 7.2 Isolation pads shall be provided under the units
- 7.3 Drain line shall be provided from indoor unit upto drain point
- 7.4 Suitable M.S. angle iron supporting frame shall be provided for the condensing units and supporting arrangement for the indoor units.
- 7.5 Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit and cabling between the main control panels to the units

8.0 Testing and Commissioning

- 8.1 The refrigeration system shall be thoroughly tested for any leaks by pressurising with dry nitrogen to a pressure of 350 PSIG. Each joint and flare connection shall be checked for any leakage with soap solution. Any leaks shall be rectified and the above process shall be repeated till no leak is detected. The pressure in the system should stand for 1 day.
- 8.2 The system shall then be vacuumized to 7.6mm Hg absolute and maintained at this level for 4 - 6 hours. Thereafter the vacuum pump shall be stopped and vacuum maintained for 24 hours. Pressure rise should not exceed 2.5mm of water absolute.
- 8.3 The vacuum shall then be broken with dry nitrogen and system again vacuumized to 7.6mm Hg maintained for 4 hours. This procedure shall be repeated for a third time before charging refrigerant gas.
- 8.4 The contractor shall set all safety and capacity controls and interlocks, properly and a record of all settings shall be furnished before commissioning the plants.
- 8.5 Testing and commissioning shall be carried out in the presence of Architect/Consultant or his representative to his entire satisfaction.

9.0 Painting

All equipments, including mounting frames and interconnected piping etc shall be painted with two coats of approved enamel paint.

HEATING & REHEATING SYSTEM

1. General:

The electric heating system and hot water heating system shall comply with the specifications as laid down.

2. Electric Heaters:

- 2.1 The heaters shall be enclosed type with external fins for heat radiation.
- 2.2 The heating element shall be of superior grade Nichrome wire of required resistance for the specified capacity.
- 2.3 The heating element shall be enclosed in aluminium sheet casing with suitable insulator blocks to prevent grounding.
- 2.4 The aluminium casing shall have aluminium fins spaced at least 4 inch. The fins should have a snug tight fit over the casing.
- 2.5 The heater terminals shall be secured at one end through insulated connectors.
- 2.6 The individual heater shall be secured at one end through insulated connectors.
- 2.7 The heater shall be supplied in sets of 3 heaters, for balanced loading of 3 phase and neutral supply.

3. Heater Frames :

Each bank of heaters shall be mounted on aluminium angle frame work of suitable size and length to suit the heaters.

4. Contactors :

Each bank or banks of heaters shall be controlled through a contactor of ample rating and having a 220 volt holding coil. The contractor shall be indication lamps etc. as specified. The heaters shall be interlocked electrically with the fan so that these are shut off in the event of fans break down.

5. **Heating Thermostats:**

Each group of heaters shall be controlled by one single stage for preheater and one two stage snap acting heating thermostat for reheaters.

6. **Humidistat:**

There shall be one snap acting dehumidifying humidistat in parallel with the single stage heating thermostat. They shall be used for reheater control in monsoon.

7. **Safety Thermostat:**

Each group of heaters in a unit shall be provided with a heating safety thermostat having manual reset.

8. **Controls:**

The safety thermostat and other controls shall be interlocked with the motor and shall be as specified under controls.

Pan Type Humidifier

Type :

The pan type humidifier shall be closed type and connected to the supply air duct for introduction of steam when required.

Construction

The body of the humidifier shall be fabricated out of stainless steel sheet at least 2mm thick with all joints welded with stainless steel welding rods and all edges rounded off. The pan shall be made completely air tight and leak proof. On top of the pan an openable cover shall be provided for maintenance of internal components.

The humidifier shall be externally insulated with Resin bonded fibreglass of density not less than 32 Kg/cub.m and then cladded with 0.8 mm thick aluminium sheet.

The humidifier shall have two chambers with two banks of heaters. One bank of heaters shall always remain ON when the AHU is in operation to maintain the temperature of water between 60 - 70 deg. C and the other bank should come on when there is signal from the humidistat for humidification.

The electric heaters shall be submersible type made out of incloy sheeth and brass/bronze flanges. The heaters shall be of suitable rating to produce instant steam when required.

Electrical panel (Pan type Humidifier)

The electrical panel box shall be made of 16 GCRC sheet and painted with heat and water resistant paint. All switchgears and internal components of the panel shall be of L&T/Seimens/EE make only.

Controls and accessories:

The humidifier shall be complete with following controls and accessories:

- a. Water proof light in the tank
- b. Water level indicator
- c. Low water level cut-off switch
- d. Float valve with bronze ball
- e. Make up , quick fill and drain connections
- f. Safety thermostats.
- g. Fault indication lamp.

AIR COOLED SPLIT AIR CONDITIONER

1 SCOPE

Scope of this sub-section comprises the supply, erection, testing and commissioning of Air-cooled split air conditioners conforming to these specifications and in accordance with the technical 'schedule of equipment' and 'bill of quantities'.

2. TECHNICAL SPECIFICATIONS

The split type air conditioners shall have an actual operating capacity as required in the specifications. The tenderer shall clearly indicate the MAKE/MODEL/ACTUAL capacity of the units under actual working conditions and also enclose the manufacturer's literature and clearly mark the models of the units and complete selection data.

3. CONDENSING UNITS

The condensing unit will be provided with single or two serviceable hermetically sealed compressors suitable for $415 \pm 10\%$ volts, 3 phase, 50 HZ. The unit will be capable of providing the specified design minimum refrigeration capacity at design ambient conditions, without the help of any addition of water. The unit should be suitable for location in the open exposed roof outside weather without any damage/rust in the casing and other parts.

The compressor shall be hermetic, with enclosed gas cooled motor. The compressor's shall be suitable for R-22.

The condenser coil shall be air cooled type with aluminium fins and copper tubes and necessary refrigerant connections. The copper tubes shall not be less than 1/2" O.D.

The condenser air fan(s) shall be propeller type direct driven, each complete with motor. The air quantity and area of the condenser shall be adequate for working in the specified outdoor conditions.

The casing shall be fabricated from galvanised steel, zinc phosphated and finished with baked enamel paint. The casing shall make the whole unit fully weather proof, suitable for outdoor installation.

The necessary change of refrigerant gas and lubricated oil shall be provided to run the system.

4. EVAPORATIVE UNIT

The evaporative unit shall be as specified in Technical Schedule of Equipment complete with cooling coil of adequate size, synthetic fibre cleanable filters minimum 25 mm thick with face velocity not exceeding 106 mpm, centrifugal blower. the casing shall be heavy gauge sheet smoothly finished and fully protected against rusting.

5. REFRIGERANT PIPING

The condensing unit and evaporator unit shall be interconnected by type '1' seamless copper refrigerant liquid and suction lines using flared or brazed fittings. Necessary accessories shall be incorporated in the circuit.

The suction line shall be insulated with 6 mm rubber foam insulation.

6. MISCELLANEOUS

The unit shall have control panel, housing the starting switches, contactor, relays etc.

Isolation pads shall be provided under the units.

Drain line shall be provided from a coil up to drain trap.

Suitable M.S. angle iron supporting frame shall be provided for the condensing unit and supporting arrangement for the indoor units.

Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit

7. INSTALLATION

The proposed location of the condensing units and the evaporative units as shown in the tender drawings are tentative. Actual location will be decided in consultation with the architect and the refrigerant piping of lengths as required will be provided by AC contractor within the quoted price. The installation shall be carried out in accordance with the best engineering practices to the complete satisfaction of the consultant to ensure proper return, and installation free from vibration and noise considered objectionable. Apart from other operational and safety controls provision will be made for manual reset with HP/LP cut out and for non-recycling control relay.

8 TESTING

The actual refrigeration capacity of the evaporative unit as tested at site shall not be below the capacity under the specific conditions as contained in the manufacturer's literature forming a part of the contract - but in no case less than the capacity specified in the tender.

9. PAINTING

The AC contractor shall be responsible to restore the equipment to original condition in case of any scratches or damages to the equipment up to the time of the handing over the same to the owner.

10. TECHNICAL DATA TO ACCOMPANY BIDS

Tenderer shall submit with tender complete technical data for selection of various components supported by the relevant literature

VENTILATION FANS

1. **General:**

The ventilation fans shall be complete in all respects and shall generally comply with the following specifications given below:

2. **Exhaust Fans:**

- 2.1 The exhaust fans shall be propeller type with steel hub and blades, mounted directly on the shaft of a totally enclosed motor.
- 2.2 The fan blades shall be of pressed steel of aerofoil design for high efficiency and static pressure.
- 2.3 The mounting frame shall be of cast/sheet steel with steel brackets to connect the frame, with the fan/motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.
- 2.4 The fan motor shall be to totally enclosed squirrel cage type.

3. **Centrifugal Blowers:**

- 3.1 The centrifugal blowers shall be double/single inlet, double/single width, non-overloading type, of suitable construction. The blower performance must be rated in accordance with approved test codes and procedures.
- 3.2 The blower housing comprising of scroll & side plates shall be accurately cut, heavy gauge all welded sectional construction and reinforced with angle bracings. Outlets shall be flanged to assure proper duct connections. Inlet cones shall be spun venturi type or curved vane type to ensure smooth air entry. The base frame shall be of angle iron in bolted/welded construction.
- 3.3 Impeller shall be fabricated from sheet steel with backward curved, properly designed blades, heavy c.i. hub and shall be both dynamically and statically balanced, to a close tolerance for quiet and vibration free performance.
- 3.4 Shaft shall be of hot rolled steel or forged steel, sized adequately, but in no case less than 40 mm dia-meter and shall be accurately ground and polished to a close tolerance.
- 3.5 Bearings shall be self aligning, heavy duty ball or tapered roller type with integral dust and grease seals.

- 3.6 After assembly, the complete fan shall be painted with rust proof primer and two coats of synthetic enamel paint.
- 3.7 Fan having wheel diameter of 1220 mm or more, shall be supplied with split, bolted housing for convenience of handling and installation.

4. **Blower Drive Assembly:**

- 4.1 Drive assembly for each blower shall consist of blower pulley, motor pulley, a set of 'V' belts, belt guards, and belt tension adjusting device.
- 4.2 Pulleys shall be selected to provide the required speed. They shall be multi-groove type, with section and grooves selected to transmit 33% more load than the required power and shall be statically balanced.
- 4.3 The belt guards shall be of m.s. sheet with angle iron reinforcement and expanded metal screen.

5. **Exhaust Blowers (Fan Section of AHU)**

- 5.1 The exhaust fans (fan section of AHU) shall be as described in under AHU.

6. **Motors and Starters:**

- 6.1 The motor for each blower shall be squirrel cage induction type and conform to specifications as given under section on control panel, motors and switchgear. The motor h.p. shall be at least 20% more than the limit load of fan and of minimum rating as given under 'Schedule of Equipments'.

7. **Limitation:**

The air velocity limits are as follows :

- 7.1 Velocity at blower outlet shall not exceed 12.5 mps.

8.0 **AXIAL FLOW FANS**

Casing shall be constructed of heavy gauge sheet steel. Casing shall be provided with hinged door enabling easy replacement of wheel, shaft and bearings. A small inspection door with handle and neoprene gasket shall also be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspension shall be welded to the casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be de-rusted, cleaned, primed and finish coated with enamel paint.

- ii) Rotor hub and blades shall be of cast aluminium, or cast steel construction. Blades shall be die-formed aerofoil shaped for maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Fan blade mounting on the hub shall be statically and dynamically balanced. Extended grease leads for external lubrication shall be provided. The fan pitch control maybe manually readjustable at site, upon installation, for obtaining actual airflow values, as specified.
- iii) Motor shall be of 3 phase squirrel-cage totally enclosed, fan cooled type. Motor and starter shall be in accordance with para 6.6. (V) and 13.9. The speed of fan shall not exceed 1000 RPM for fans with impeller diameter above 450 mm, and 1450 RPM for fans with impeller diameter of 450 mm and less.
- iv) Drive to fan shall be provided through belt drive with adjustable motor sheaves and belt guard or direct driven. Belt shall be oil resistant type.

CONTROLS

1.0 General

- 1.1 The various controls listed below shall be electrically operated and generally comply with the specifications listed below.
- 1.2 In case of low voltage controls, necessary step down transformers shall be provided with each control as required.

2.0 Modulating Humidistat

The humidistat for humidification shall be snap acting type as per clause 2.5.

2.1 Snap Acting Humidistat

The humidistat for humidification shall be snap acting type with an adjustable differential. The sensing element shall be horse of hair or other accurate device.

2.2 Reheat Thermostat

The reheat thermostat shall be 2 stage snap acting type for room mounting, with 1 deg. C differential.

2.3 Winter Heating Thermostats

The winter heating thermostat shall be to stage snap acting type for room mounting with 1 deg. c differential.

3 Refrigerant Control

3.1 Expansion Valve

The thermostatic expansion valve shall be with external equaliser lines and capillary with "Bulb" for producing super heat.

3.1 Solenoid Valves

The solenoid valve shall be pilot operated with packless seat to ensure leak proof shut off. The pressure drop across the valve shall not exceed 5 psig.

3.2 Temperature Control

- 3.2.1 The water temperature controller shall be snap acting capillary type with a range of 0° F. to 100° F. and a temperature differential of 2deg f adjustable in the field.

3.3 Safety Controls

3.3.1 Antifreeze Thermostat

The antifreeze thermostat shall be snap action type with a range of -12° c. to +10° c. It should be complete with a reset button to prevent restarting of the compressor.

3.3.2 High and Low Pressure Cutout

The high and low pressure cutout shall be of snap acting type with adjustable set point and differential and range suitable for R-22/R-134a pressure. The high pressure cutout should also have a reset button to prevent restarting of the compressor.

3.3.3 Oil Failure Switch

The oil failure switch if required shall be snap acting type with suitable adjustable range and differential and complete with reset button. It should also have a time delay relay for start up of the compressor.

4.0 Gauges

The water pressure gauges shall be of robust construction with minimum 100 mm dial, of suitable range and occupancy calibrated.

5.0 Thermometers

The thermometers shall be mercury filled industrial stem type, with metal casing and threaded fixing arrangement.

MOTOR & SWITCHGEARS MOTOR STARTERS CONTROL PANELS

1.0 General

The motors and switchgears required for various items shall generally be as per specifications given below. All electric motors shall be suitable for 3 phase, 50 cycles 415 volts A.C. supply.

2.0 Control Panel

2.1 These panels should be floor/wall mounted, sheet steel clad, modular construction, cubicle design, compartmentalised .These panels shall comprise of incoming & outgoing feeders (circuit breakers, fuse switch units/switch fuse units, contactor starters with overload relays, single phasing preventor etc. as indicated in the drawings.

2.2 The panels shall be provided wherever necessary with necessary interlocks designed to prevent incorrect operation and to ensure safety of operating personnel and equipment.

2.3 All feeders are to be operated from the front and they shall be interlocked suitably. Padlocking arrangement and interlock defeating device shall also be provided. Each module shall have separate door and partition plate. The feeder incomer switches shall be interlocking with the door so that the door can only be opened when switch is in `off` position. The doors and covers shall be provided with thick gaskets to make it dust tight. All the door covers shall be provided with synthetic rubber gaskets to make it dust tight. Feeder name tags shall be provided.

2.4 Air Circuit Breaker and Fuse Switch Units

The circuit breaker shall be air break fully draw out type equipped with arc chutes and their face barriers of proper design. The continuous current rating of the circuit breakers shall be as given in the detailed technical specifications. The circuit breakers shall have a breaking capacity of 31 MVA at 415 volts, 50 hz ac & they shall be able to withstand full fault current for one second.

2.5 The circuit breaker shall be provided with manually operated spring closing mechanism. The operating mechanism shall be trip-free throughout the breaker travel. The breaker shall be equipped with inside `on` & `off` position indicator mechanism and so located that the position of the circuit breaker i.e. whether closed or open, is indicated on the front door of the compartment. The `on` & `off` trip indicating lights shall also be provided for each breaker feeder.

2.6 The moving portion of the circuit breaker shall be so interlocked that it is not possible to isolate it and draw out from the service position or to plug it in from the isolated position when the circuit breaker is closed. The interlock being provided shall be

such as to prevent operation of a circuit breaker unless it is fully plugged in or fully isolated and is locked correctly in either of the two positions.

- 2.7 The circuit breaker compartment doors shall be so interlocked as to prevent access to the breaker while in the plugged in position. However special means shall be provided for undoing this interlocked in an emergency.
- 2.8 The draw out feature shall clearly provided three distinct positions of the circuit breaker viz., 'service', 'test' & isolated. Inadvertent withdrawal of a circuit breaker removable unit too far beyond its supports shall be prevented by a suitably interlock, the design shall provide for the testing of breaker in the test positions i.e. when the breaker's moving unit is in fully disconnected position and the secondary circuit remains connected or energised. The secondary connections between the fixed and removable units shall be provided with means of spring loaded sliding type contacts to make the breaker fully draw out type.
- 2.9 The circuit breaker unit shall be provided with complete range of releases including the overload releases and release for short circuit protection.
- 2.10 The circuit breaker shall be provided with necessary auxiliary contacts with 2 No. spare contacts. All contacts shall be wired up to the terminal board.
- 2.11 The fuse switch unit shall be of load break heavy duty, industrial design and of double break pattern with quick make and quick break mechanism, however, the design shall be such that it shall ensure positive opening even if quick break action is lost due to spring stretching or breaking.
- 2.12 The 'on' and 'off' position of the switch handle shall be distinctly indicated and interlocks shall be provided to ensure that switch cover can not be opened unless the switch is in the 'off' position.
- 2.13 The fuse switch units shall be provided with non-deteriorating type of HRC cartridge fuse link and having rupturing capacity not less than 31 MVA at 415 volts.
- 2.14 All live parts inside switch shall be properly shrouded and inter phase barriers shall be provided. Design of the switch handles shall be such that they do not protrude out of the panel in the manner so as to prevent free passage of operating personnel. Design with normal conventional position of switch handle up in 'on' position & down in 'off' position shall be preferred.
- 2.15 **415 Volts Bus Bars**

The 415 volts main bus-bar shall have continuous current rating as indicated in the specification or equivalent standard rating of at least 50 percent of these of the phase bus bars. The bar and its connections shall be so arranged and supported as to withstand without any damage or deformation, the specific short-circuit current. The bus bars shall be braced and supported on reinforced fibre glass support and shall be of electrolytic grade type E 91e of IS: 5082. These bus bars shall withstand 43.12 ka for one second during short circuit conditions. The bus bars shall be colour coded with PVC tapes or insulating painting for identification purposes. The bus bars shall

be sleeved with special type heat shrinkable PVC sleeving.

- 2.15.2 The main three phase and neutral horizontal bus bar shall be located in top isolating chamber extending throughout the length of the switch board. Bus bars shall have withstand capacity of 43.12 ka RMS and shall be mounted on reinforced fibre glass supports at intervals suitable for prescribed conditions of short circuit and other standards. The neutral bus bar shall run all along the length of the board.
- 2.15.3 Power shall be distributed to the outgoing or incoming control units in each section by a set of vertical bus bars three phase and neutral. The vertical bus bars shall be isolated from control compartments by suitable metallic barriers or by insulating sleeve on each bus and supported in liberally designed reinforced fibre glass insulating plates spaced as per standards suitable joints shrouds detachable type shall be provided on bus bar joints.
- 2.15.4 Bus supports shall be resistant low absorption type moulded insulation of high impact strength and high creep age surface.
- 2.15.5 All bus work shall be braced to withstand without damage a short circuit current of 43.12 ka symmetrical for one second.
- 2.15.6 The vertical bus bars for different sets of panels shall be connection should not be painted.

2.16 Instruments and Meters

- 2.16.1 Current transformer shall comply with the requirements of IS: 2705. They shall have ratio outputs and accuracies as specified or required as shown in single line diagram.
- 2.16.2 All indicating instruments shall be of industrial pattern and should be provided as shown in the single line diagram.
- 2.16.3 All instruments shall be switch board type flush mounted with proper scale dimensions so as to be clearly visible to the operators standing on the floor. The instruments shall be provided with front of board zero adjuster shall be not preferably be mounted at heights lower than one meter and higher than two meters above the floor level.
- 2.16.4 The operating handles, meters, instruments etc. shall be mounted at the front of the switch board. Approved means shall be provided for locking the control switch/operating handles in the open position. For fuse switch gear section of the switch board, meters where specifications shall be mounted in such a manner that it is possible to readily identify the meters for individual units and the arrangements does not create hindrance to maintenance of individual units without having to shut down the bus.
- 2.16.5 All wires carried within the switch gear enclosure shall be PVC insulated and shall be neatly arranged to be readily accessible and to facilitate easy replacement. Only PVC copper cables shall be used for all power and control inter connections. The cables of 660 volts shall be used. Trained copper cables lugs shall be used. All small wires

shall be colour coded and provided with numbered ferrules for easy identification of circuits. As far as possible, each essential circuit shall be connected within the respective switch gear unit. Control wiring terminal shall preferably be near the panel.

3.0 Cable Termination

3.1 The cables entries and terminals shall be provided in the switch board to suit the number, type and size of aluminium conductor cables as given in the line diagrams. Cable entries shall be so designed as to avoid damage to cables and there shall be sufficient space to avoid short bending of cables. The positions of the cable lugs and terminals shall be such that the cable could be neatly drawn and connected through one meter deep trench below the switch gear and the jointing carried out in a convenient and satisfactory manner. The cable entry, design panel, cable boxes and terminals and their locations will have to be approved by the engineer/owner. However the access for cabling shall preferably be from the back of the switch board. The panels shall be provided with control transformers of suitable VA rating along with control bus and hr fuses from control supply to contractors.

3.2 The cables socket shall be of copper and of crimping type. Cables risers shall be adequately supported to withstand the effects of rated short circuit current without damage.

3.3 Cable glands of sizes as required shall be provided at all cable entry points in the bottom plate. The glands shall form part of switch board.

4.0 Indication

Each incoming and outgoing feeder units shall be provided with 'on' 'off' indicating lamps of standard conventional colour coding.

5.0 Subsidiary Panels

Subsidiary panels shall be provided wherever required such as AHU room, air washer room. The construction of these panels should be similar to the main panel and shall have all related accessories.

6.0 Contactor Starters

6.1 Star Delta Starter

The star delta starter shall be air break automatic contactor starter provided with main contactor, star contactor, delta contactor, timer and automatic change over from start to delta, bimetallic over load relay, operating coil, start/stop push button, single phasing preventor, auxiliary make and break contacts, indicating lamps etc. The contactor shall quick make, quick break, double break consisting of robust silver contacts. The coil voltage shall be 415 volts ac at 50 hz. The starter shall be provided with trip indication light and overload reset push button for overload relay.

6.2 **DOL Contactor Starter**

The contactor shall be air break type coil operate, dol contractor starter, provides with cables entries, ambient temperature compensated bimetallic over load relay, single phasing preventor, solenoid coil, start and stop push buttons, 8 auxiliary make and break contacts, indicating lamps etc. The contactors shall be quick make quick make and quick break, double break type consisting of robust silver contacts. The coil voltage shall be 440 volts at 50 c/s. The starter shall be provide with trip indication light and over load reset bush button for overload relay.

DUCT WORK AND OUTLETS

1.0. General

- 1.1 The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, exhaust system ready for operation as per drawings.
- 1.2 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.
- 1.3 Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2.0 Duct materials

- 2.1 The ducts shall be fabricated from galvanized steel sheets class VIII GSS sheets conforming to IS:277-1962 (revised) or aluminium sheets conforming to IS:737-1955 (wherever aluminium ducts are specified) .
- 2.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in is: 655-1963 with amendment-i (1971 edition)

The thickness of the sheet shall be as follows: -

	size of duct	sheet thickness		type of joints	bracing if any
		GI	Aluminium		
2.2.1	Upto 750mm	0.63 mm	0.80 mm	GI flange	
2.2.2	751 mm to 1000 mm	0.80 mm	1.00 mm	25x25x3 mm angle iron frame with 8 mm dia. nuts & bolts.	25x25x3 mm at the rate of 1
2.2.3	1001 mm to 1500 mm	0.80 mm	1.00 mm	40x40x5 mm angle iron frame with 8 mm dia. nuts & bolts.	40x40x3 mm at the rate of 1
2.2.4	1501 mm to 2250 mm	1.00 mm	1.50 mm	50x50x5 mm angle iron	40x40x3 mm at the rate of 1.2

to be cross
braced
diagonally with 10
mm dia nuts &
bolts at 125
mm centre.

- 2.2.5 2251 mm and above 1.25 mm 1.80 mm 50x50x6 mm angle iron frame with 10 mm nuts & bolts at 125 mm centre 40x40x3 mm at the rate of 1.6
- 2.3 The gauges, joints and bracings for sheet metal duct work shall further conform with the provisions as shown on the drawings.
- 2.4 Ducts larger than 450 mm shall be cross broken, duct sections upto 12 00 mm length may be used with bracing angles omitted.
- 2.5 Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 deg. Angle from the axis of the main duct unless otherwise approved by the engineer-in-charge.
- 2.6 All ducts shall be supported from the ceiling/slab by means of M.S..rods of 9 mm (3/8") dia with M.S. angle at the bottom.

3.0. Installations

- 3.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of engineer-in-charge.
- 3.2 Great care should be taken ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.
- 3.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. all joints shall be tight and shall be made in the direction of air flow.

The ducts shall be reinforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

- 3.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice the sheet metal gauges and fabrication procedures as given in IS specifications shall be adhered to and shall be considered as an integral part of these specifications.

- 3.5 The duct work shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted airconditioning duct design and subject to the approval of the engineer-in-charge. The contractor shall verify all measurements at building and shall notify the engineer-in-charge of any difficulty in carrying out his work before fabrication.
- 3.6 Sponge rubber of approved equal gaskets shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles. sheet metal connections shall be as shown in the drawings or as directed by engineer-in-charge.
- 3.7 The ducts shall be supported from the structure by means of suitable supports grouted in the R.C.C. work. The type of support should meet the approval of the engineer-in-charge and should involve minimum damage or breakage. In no case the duct will be rested upon the false ceiling/boxing or on supports grouted in the wall.
- 3.8 Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminium thereafter. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
- 3.9 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by engineer-in-charge.
- 3.10 Joints requiring bolting or riveting may be fixed by hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All fixing must have a permanently non-corrosive finish such as cadmium plating or galvanizing as appropriate. Spot welds and bronze welds are to be coated on all surfaces with zinc rich paint, as approved by engineer-in-charge.
- 3.11 The flexible joints are to be fitted to the suction and delivery of all fans the material is to be normally double heavy canvass or as directed by engineer-in-charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
- 3.12 The flexible joints are to be not less than 75 mm and not more than 250 mm between faces.
- 3.13 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

4.0 Dampers

- 4.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than gauge of the

large duct, and shall be rigid in construction to the passage of air.

- 4.2 The volume dampers shall be of an approved type, lever operated and complete with locking devices which will permit the dampers to be adjusted and locked in any positions.
- 4.3 The dampers shall be of splitter, butterfly or louver type. the damper blade shall not be less than 1.25 mm (18) gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm angles shall not interface with the operation of dampers, nor cause any turbulence.
- 4.4 Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.5 mm steel and blades shall not be over 225 mm wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with fine mesh spacing.
- 4.5 Wherever required for system balancing, provide a volume balancing opposed blade damper with quadrant and thumb screw lock. Provide damper rod and damper block with upset screws.
- 4.6 After completion of the duct work, dampers are to be adjusted and set to deliver the required amounts of air as specified on the drawings.
- 4.7 The fire dampers shall be provided wherever shown on the drawings. The damper shall be multi blade type as per drawings. The blades shall be minimum 1.6 mm thick mild steel. The frame shall be of 1.6 mm thickness. Other materials shall be as per the drawings attached and shall include return spring, locking device, fusible link etc.

5.0 Access panel

A hinged and gasketed access panel shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct work.

6.0 Miscellaneous

- 6.1 All ducts above 450 mm are to be cross broken to provide rigidity to the ducts.
- 6.2 All duct work joints are to be true right angle or approaching with all sharp edges removed.
- 6.3 Sponge rubber gaskets also to be provided behind the flange of all grilles.
- 6.4 Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.
- 6.5 Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by engineer-in-charge.

- 6.6 Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.
- 6.7 Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations additional supports are to be provided where required for rigidity or as directed by engineer-in-charge.
- 6.8 The ducts should be routed directly with a minimum of directional change.
- 6.9 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the engineer-in-charge, at no extra cost.
- 6.10 All duct supports, flanges, hangers and damper boxes etc. shall be given 2 coats of red oxide paint before installation and one coat of aluminium paint after the erection, at no extra cost.
- 6.11 All angle iron flanges to be welded electrically and holes to be drilled.
- 6.12 All the angle iron flanges to be connected to the GSS ducts by rivets at 100 mm centres.
- 6.13 All the flanged joints, to have a 4 mm thick felt packing stack to the flanges with shellac varnish. the holes in the felt packing are to be burnt through.
- 6.14 The G.S.S. ducts should be lapped 6 mm across the flanges.
- 6.15 The ducts should be supported by approved type supports at a distance not exceeding 2.4 metres.
- 6.16 Sheet metal connection pieces, partitions and plenums required, shall be constructed of 1.25 (18 gauge) sheet thoroughly stiffened with 25 mm x 25 mm angle iron braces and fitted with access doors.

7.0 Grilles

- 7.1 The supply and return air grilles shall be fabricated from aluminium extruded sections the supply air grilles shall have single/double louvers. The front and rear louvers shall be of extruded section, fixed/adjustable type the return air grille shall have single horizontal extruded section fixed louvers the grilles may or may not be with an outer frame.
- 7.2 The grilles shall have opposed blade dampers of G.I. black sheets, which shall be key operated from the grille face wherever required.
- 7.3 The damper blades shall be of 0.80 mm (22 gauge) G.I. black sheets and shaped to form air tight joints the frame work for dampers shall be fabricated from 1.00 mm (18 gauge) M.S. black sheet the grill flange shall be fabricated out of 25 x 25 x1.5 mm aluminium angle grilles longer than 450 mm shall have intermediate supports for the horizontal louvers.

8.0 Diffusers

- 8.1 The ceiling type round or square diffusers shall be of extruded aluminium sections with flush or step down face, as specified with fixed pattern and round neck.
- 8.2 The diffusers shall be die formed for proper air diffusion.
- 8.3 All supply diffusers shall be provided with m.s. sheet dampers, with knurled knobs for adjustment from the bottom.

9.0 Linear Grille

- 9.1 The linear grille shall be of extruded aluminium sections flush mounted with single or double direction air flow adjustment louvers..
- 9.2 The diffusers shall be die formed for proper air diffusion.

11.0 Painting

- 11.1 All grilles, and diffusers shall be anodised or powder coated as per the requirements of the interior decorators to the approved colour to suit the interiors
- 11.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.
- 11.3 All grilles, diffusers and registers shall be provided with rubber gasket between flanges and the wall or ceiling.

12.0 Testing

- 12.1 After completion, all duct system shall be tested for air leakage.
- 12.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the engineer-in-charge for approval.

PIPE WORK

1. General:

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder: -

2. Arrangement and Alignment of Piping:

- 2.1 All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the engineer-in-charge.
- 2.2 The piping shall be installed in a uniform manner, parallel to or perpendicular to walls or ceilings, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angles and shall not run diagonally across rooms or other piping. Wherever possible all piping shall be arranged to provide maximum head room.
- 2.3 All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route this contractor shall reroute his pipes as required to avoid interference, at the discretion of the engineer-in-charge.
- 2.4 All piping shall be carefully installed to provide for proper alignment, slope and expansion.
- 2.5 The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.
- 2.6 Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.
- 2.7 Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor excessive in length, but shall be installed neatly, carefully bent at all changes in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.
- 2.8 The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

3. Testing:

- 3.1 In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, equipment or appliances be subjected to pressures exceeding their test ratings.
- 3.2 The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank-offs or flanges.

- 3.3 After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fillings and debris.
- 3.4 All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/sq.cm for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the engineer-in-charge, without any extra cost.
- 3.5 All the piping systems shall be tested in the presence of the engineer-in-charge or their authorised representative. Advance notice of test dates shall be given and all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by engineer-in-charge in order to avoid hindrance in the work of the insulation contractor.
- 3.6 All steam and condensate pipes shall be tested and proven tight under hydrostatic pressure of 20 kg/sq. cm, unless otherwise stated, for a minimum period of 4 hours without drop in pressure.
- 3.7 Miscellaneous piping, tests with air at 10.5 kg/sq.cm for a minimum of 24 hours without drop in pressure.
- 3.8 The contractor shall make sure that proper noiseless circulation is achieved through all piping systems. If due to poor bond, proper circulation is not achieved, the contractor shall bear all expenses for carrying out the rectification work including finishing of floors, walls and ceiling damaged in the process of rectifications.
- 3.9 The contractor shall provide all labours and materials to make provision for removing water and throwing it at the proper place, during the testing or/and after the testing to avoid damages to employer or other contractors ' properties. Any damages caused by the contractor to the employer or other contractors' properties, shall be borne by the contractor.

4. **Copper Piping:**

- 4.1 Heavy gauge soft copper tubing, type m shall be used to make connections to equipment, wherever required or specified by engineer-in-charge.
- 4.2 Flare fittings e.g. flare nuts, tees, elbows, reducers etc. shall all be of brass.

5. **Refrigerant Piping:**

- 5.1 The refrigerant circuit piping shall be heavy class m.s the fittings shall be heavy class. The pipes and fittings shall be connected by means of welded joints. The connections to gauges, controls etc. shall be with soft copper tubing and flare fittings.
- 5.2 The refrigerant valves, required in the circuit shall be as follows.

	Valve Size	Valve Material	Type of Connections
5.2.1	upto 12 mm	brass/packless type	flare fittings
5.2.2	16mm & above	brass/steel packed type	brazed/welded

Note :- all valves shall be tested against leaks upto 20 kg/sq.cm.

5.3 The strainers for the refrigerant liquid line shall be 'y' type with gun metal body and bronze filter screen of fine mesh. The filter screen shall be easily removable type without dismantling the strainer from the circuit.

5.4 The moisture indicator in the liquid line shall have leak proof glass on opposite sides to permit easy inspection of the liquid refrigerant.

6. Drain Piping:

6.1 The drain piping shall be medium class galvanised steel as per is 1239/1979.

6.2 The fittings shall be of 'R' brand or equal forged with screwed connections.

6.3 The gate valves shall be of gun metal as described earlier.

6.4 Pipe crosses shall be provided at bends, to permit easy cleaning of drain line.

6.5 The drain line shall be provided upto the nearest drain trap and pitched towards the trap.

6.6 Drain lines shall be provided at all the lowest points in the system, as well as at equipments, where leakage of water is likely to occur, or to remove condensate and water from pump glands.

7. Painting:

7.1 All pipes supports, hangers, etc., shall be given two coats of red oxide primer.

7.2 All pipes, which are not to be insulated, shall then be given one coat of finish paint, of a type and colour, as approved by the engineer-in-charge.

INSULATION

1.0 General

The insulation of water piping, air handling units, ducting, chillers etc., shall be carried out as per specifications given below:

2.0 Materials

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere.

2.1 Pipe Insulation

The insulation for chilled water/ hot water and drain piping, chillers, pump etc. shall be carried out from 'TF' quality expanded polystyrene having a 'K' value of 0.014 kcal/hr/°C at mean temperature of 10°C and a density of 20 to 24 kgs/ cub.m.

2.2 Other Insulation

2.2.1 The material for acoustic treatment of ducts, rooms, roofs etc. shall be resin bonded fibre glass, as described earlier, conforming to I.S. 8183 of 1976. the density of fibre glass shall be 32 kg/cub.m and the material shall be in the form of slabs of uniform density. The 'K' value at 10°C. shall not be less than 0.028 kcal/mhr/°C. Facing shall be provided with 0.5 mm perforated aluminium sheet held with G.I. nuts bolts or nailed to the batten work as required.

2.2.2 The materials for duct insulation shall be resin bonded glass wool, as described earlier but conforming to I.S. 8183 of 1976. The density of insulation shall not be less than 24 kg/cub/m. and material shall be in the foam of blankets/rolls of uniform thickness. The 'K' value at 10°C. shall not be less than 0.03 kcal/m hr/deg.C.

3.0 Air Handling Units

3.1 The casing of the sheet metal type air handling unit from the beginning of the fan section till the end of the coil section, including the drain pan, shall all be insulated.

3.2 The insulation shall be 12 mm polyethylene flexible sheets.

3.3 The insulation shall first be fixed to the casing by applying cold sticking compound both to the surface and the insulation and all joints shall be sealed completely.

4.0 Cold Equipment Insulation

4.1 The complete shell of the Chiller as well as its two heads, the chilled water pumps, and high pressure AHU's shall all be insulated.

4.2 The insulation shall be 'TF' quality expanded polystyrene as below:

- i) Chillers - 100 mm
- ii) High pressure AHUs - 50 mm
- iii) Chilled water pumps - 50 mm

4.3 All insulation excepting Chiller heads shall be covered with 0.63 mm 12 mm wire netting and finished with 12 mm thick sand cement plaster.

4.4 The insulation on the two end heads of the Chiller shall be covered with 0.80 mm G.I. casing to permit easy removal.

4.5 Insulation (Chiller)

4.5.1 The cooler surface shall first be cleaned with wire brush.

4.5.2 Then one layers of cold setting compound shall be applied.

4.5.3 The insulation shall then be fixed in two layers, staggering the joints and sealing them with cold setting adhesive.

4.5.4 The insulation shall then be covered with 0.63 mm 19 mm mesh wire netting which shall be fixed to the insulation with brass 'U' nails.

4.5.5 The final finish shall be 12 mm sand cement plaster which shall be applied in two layers of 6 mm each and trowelled to a smooth round finish.

4.5.6 After the insulation is fixed on the head as above, it shall then be covered with a properly shaped jacket of 0.80 mm G.I. sheet. Pump casing shall be finished with aluminium cladding.

4.6 Insulation (Others)

The AHUs and the chilled water pumps shall be insulated as above in 4.5 and finished with plaster excepting that the insulation of 30 mm shall be fixed in a single layer.

5.0 Chilled/Hot Water Piping/Drain Piping

5.1 The chilled/hot water and drain pipes shall be insulated with 'TF' quality expanded polystyrene. The thickness of the insulation for chilled/hot water pipes will be 50 mm and for drain pipes will be 25 mm.

5.2 Prefomed pipe sections shall be used for pipes upto and including 350 mm dia.

5.3 Pipes above 350 mm dia. shall be insulated with insulation slabs cut in mitred sections.

5.4 Installation

Chilled/Hot Water and Drain Piping

- 5.4.1 The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.
- 5.4.2 The pipes shall be treated with a coat of cold setting compound.
- 5.4.3 The insulation preformed section shall be fixed tightly to the surface taking care to seal all joints.
- 5.4.4 All joints along the circumference of the pipe sections shall be sealed with adhesive.
- 5.4.5 The insulation than shall be covered with 0.63 mm x 19 mm mesh wire netting than finally finished with 12 mm sand cement plaster in two layers of 6 mm each and given to a smooth round finish.
- 5.4.6 Insulation on pipes in areas exposed to weather or underground shall additionally be covered with tar-felt sheets manufactured by shalimar tar products (1935) ltd. and fixed with G.I. wires of 1.0 mm. The tar felt sheet shall be stuck with bitumen r 85/25.

6.0 Refrigerant Piping

- 6.1 The suction line of refrigerant piping shall be insulated with 50 mm thick expanded polystyrene as specified for chilled/hot water pipe lines.

7.0 Ducting

- 7.1 The air handling ducts shall be insulated with resin bonded glass wool with density not below 24 kg/cub.m.

- 7.2 Duct insulation thickness shall be as follows:

Duct in conditioned space - 25 mm thick

Duct in unconditioned space - 50 mm thick

Duct with treated fresh air - 50 mm thick

7.3 Installation

- 7.3.1 Clean the surface with a wire brush and make it free from rust and oil.
- 7.3.2 Apply one coat of cold setting compound.
- 7.3.3 Wrap the duct with insulation blankets of the thickness mentioned in item 7.2 above and then with 250 g polythene sheet and covered with 0.1mm thick .aluminium sheet using 50 mm wide aluminium adhesive tape of Johnson make.
- 7.3.4 Reinforce and tie with G.I. wire of 1.0 mm at intervals of 450 mm.

7.3.5 The ducts in areas exposed to the weather shall be additionally covered with one layer of tar felt b.h. the tar felt shall be stuck with bitumen r 85/40 or 80/25.

8.0 Acoustic Lining

8.1 The acoustic lining shall consist of 25 mm resin bonded glass wool board of density 48 kg/cub.m (min) then it shall be covered by 0.5 mm perforated aluminium sheets having 3 mm perforation at 6 mm centres.

8.2 Installation

8.2.1 The duct surface shall first be cleaned from inside.

8.2.2 The insulation boards shall be wrapped in glass cloth of 7 mil thickness with the end stitched.

8.2.3 Then the boards shall be fixed inside the duct.

8.2.4 The insulation shall then be covered with 0.5 mm perforated aluminium sheets.

8.2.5 The sheet and the insulation shall be secured to the duct by means of cadmium plated bolts, nuts and washers. The ends should be completely sealed off, so that no insulation material is exposed.

9.0 Walls and Ceiling Acoustic Treatments of Plant Rooms and A.H.U. Room

9.1 Material

Resin bonded glass wool of density 32 kg/cub m of 50mm thickness.

10.0 Installation

10.1 Fix 40 mm x 50 mm g.i. sheet channel at 0.5 mtr interval longitudinally then fix cross battens at 1.0 mtr centre using suitable gutties, and brass screws. The battens & gutties shall be treated with fire retardant chemical before fixing.

10.2 Fill each rectangle with 50 mm glass wool wrapped in glass cloth.

10.3 Tie with 24 gauge G.I. wires at 300 mm intervals.

10.4 Then cover with 26 gauges (0.50 mm) perforated G.I. sheet having 3mm perforations at 6 mm centres. Overlap all joints and provide beading of 25 mm by 2 mm flats.

ELECTRIC WIRING

1.0 General

The electric wiring of motors for compressors, pumps, air handling units etc. As well as controls, heaters etc. and earthing of all equipment shall be carried out as per specifications given hereunder.

2.0 Wiring for Motors, Heaters etc.

2.1 The wiring for above equipment shall be carried out in pvc armoured cables conforming to I.S.:1554.

2.2 The PVC armoured power cable for use on 415 volts system shall be 3 or 3.5 core with aluminium conductors and be of 1100 volts grade, as per is 1554 part is-1964. The cross section of the cable shall be to suit the load or rating of the equipment. The cable shall be aluminium conductor PVC insulated single wire/strip armoured with overall PVC sheathing.

2.2.1 The cables shall be laid as per I.S. -1255/1967, Indian standard code of practice.

2.2.2 The cables shall be laid, as per drawings or along a short and convenient route between switch board and the equipment, either in trenches, on wall or on trays. Hangers, supported from the slab. Cable routing shall be checked on the site to avoid interference with structure, equipment etc. Where more than one cables are running close to each other, proper spacing should be provided between them Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms. Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air-conditioning Contractor as required.

2.2.3 The radius of bends of the cable should not be less than 12 times the radius of cable to prevent undue stress and damage at the bends, the cables should be supported and fixed on M.S. supports, when running in trenches, wall or ceiling suspended hangers when laid under ground the cables should be covered with sand and protected with cement concrete covering. Suitable G.I. pipe shall be used wherever cable is laid across road, crossing of other services and when passing through R.C.C.

2.2.4 Wooden bushes shall be provided at the ends of pipes through which cables are taken.

3.0 Control Wiring

3.1 Control cables shall be 1100 volts grade as per is 1554 with copper conductor of 2.5 sq mm PVC insulated single wire/strip armoured with an overall PVC sheathing as per is 1554.

3.2 The cabling shall be carried out as per details given under 2.2 above.

4.0 Earthing

4.1 Pipe Earth Electrode

G.I. pipe shall be of medium class 40 mm dia 4.5 m long in length. Galvanising of the pipe shall conform to relevant is. G.I. pipe electrode shall be cut tapered at the bottom and provided with holes of 12 mm dia drilled not less than 7.5 cm from each other upto 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20 cms below ground level.

4.2 Plate Earth Electrode

4.2.1 For plate electrode minimum dimensions of the electrode shall be as under:

- i. G.I. plate electrode : 60cm x 60cm x 6mm thick.
- ii. Copper plate electrode : 60cm x 60cm x 3mm thick.

4.2.2 The electrode shall be buried in ground with its faces vertical and top not less than 3 m below ground level.

4.2.3 In case of plate earth electrode a watering pipe of 20 mm dia of medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on top of this pipe for watering the earth. In case of pipe electrode a 40mm x 20mm reducer shall be used for fixing the funnel. The watering funnel attachment shall be housed in masonry enclosure of not less than 30cm x 30cm x 30cm. A cast iron/ms frame with cover having locking arrangement shall be suitable embedded in the masonry enclosure.

4.3 Loop Earthing

4.3.1 Loop earthing shall be providing for all mountings of main board and other metal clad switches and db's with G.I. strip of size specified but not less than 14 swg copper or 12 swg gi or 4 sq mm aluminium wite. The earthing lead from electrode owner's shall be suitably protected from mechanical injury by a 15 mm dia GI pipe in case of wire and 40 mm dia medium class G.I. pipe in case of strip. Metallic covers or supports of all medium pressure or ht apparatus or conductor shall in all cases be connected to not less than two separate and distinct earths.

4.3.2 All equipment connected with electric supply shall also be provided with double earthing continuity conductors. The size of G.I. earthing conductors shall be :-

Earthing should be carried out as per IS-3043

Size of phase wire Sq.mm.	Size of G.I. conductor aluminium tape/wire (swg)
185	25 mm x 4 mm (strip)
150	25 mm x 4 mm (strip)

120

20 mm x 3 mm (strip)

Size of phase wire sq.mm	Size of G.I. conductor aluminium tape/wire (swg)
95	20 mm x 3 mm (strip)
70	4 swg
50	4 swg
35	6 swg
25-6	6 swg
4	8 swg

5.0 Miscellaneous

- 5.1 The final connections to the equipment shall be through flexible connections where the equipment is likely to be moved back and forth, such as on slide rails.
- 5.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.
- 5.3 Two separate and distinct earthing conduits shall be connected from the equipment upto the main switch board panel.
- 5.5 All exposed hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

TESTS AT SITE

1.0 General

The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the architect, in accordance with the provisions of the applicable ASHRAE standards or approved equal and furnish necessary test certificates from manufacturers.

2.0 Compressors Condensers/Chillers/Evaporators/Pumps etc.

- 2.1 Identification of materials in accordance with test certificates.
- 2.2 Inspection of various laboratory test certificates for physical properties and technical composition conducted on test samples of materials to be used for fabrication, forgings etc. for all important components of various equipment.
- 2.3 Hydraulic test for various components and assembled equipments at 1.5 times design pressure or double the operating pressure whichever is higher.
- 2.4 Pneumatic leak test after assemblies at design pressure
- 2.5 Static and dynamic balancing on electronic precision machine for rotating parts, links, impellor/crank shaft assemblies etc.
- 2.6 Inspection of assemblies and dis-assemblies of various parts of equipments and complete equipments themselves as desired by inspection engineer.
- 2.7 Noise level test for various rotating/reciprocating equipments.
- 2.8 Pressure drop test for condenser, chiller and evaporator.
- 2.9 Inspection of manufacturer's test certificates shall be supplied for all electrical motors.
- 2.10 Inspection of welding including welders qualifications as desired by inspection engineers.
- 2.11 For compressor assembly, electronic leak, air running test, pneumatic test with dry nitrogen and leak test in water.

3.0 Ductable Split Type Air Conditioners

3.1 Blowers

- 3.1.1 Identification of material in accordance with test certificates.
- 3.1.2 Dynamic/static balancing of impeller.
- 3.1.3 Performance test as per applicable codes.

3.2 **Coils**

3.2.1 Identification of material in accordance with test certificates.

3.2.2 Pneumatic test.

3.3 **Filters**

3.3.1 Manufacturer's test certificates also to be produced for the assembled A.H.U. final dimensional check will be done. Inspection will be done during assembly of components for quality of workmanship, painting etc.

Piping : materials check for specifications and size.

3.4 **Valves**

Hyd./Pneumatic test certificates.

3.5 **Motors**

Manufacturer's test certificate as per motor data sheet.

3.6 **Instruments and Controls**

Visual examination for operation.

4.0 **For Associates Works at Site**

4.1 All electrical items will be subjected to inspection at any stage during manufacturing activity. Routine electrical test as per relevant codes. Inspection of manufacturer's test certificates.

4.2 Inspection of raw materials to be used for fabrication and assembly and inspection of manufacturer's certificates.

4.3 Inspection of welding including welders qualification as desired by inspection engineers. Inspection of fabricated items.

4.4 Pressure testing of pipe fit used for the refrigerant and water services.

4.5 Pressure testing, leak testing of complete piping network for chilled water. Condenser water and refrigerant/services.

4.6 Vacuumising and gas/oil charging for refrigeration system.

4.7 Checking of electrical circuits (power & controls) and checking functioning of controls of refrigerant systems and other circuits of air conditioning plant.

4.8 Checking of calibration of controls and instrumentation

- 4.9 Checking of assemblies for electrical control panel, instruments panels, local panels (dimensional and functional) annunciator panels etc.
- 4.10 Inspection of complete electrical installation at site.
- 4.11 Installation of main equipments like compressor, condenser, chiller, evaporator.
- 4.12 Performance testing of complete A/C plant as per specifications.

5.0 The above inspection procedure is given for general guidance and information of vendors and inspection of purchaser/consultant is strictly not limited to these and inspection engineer of purchaser/consultant will have full right to have detailed inspection at any stage right from placement of order to completion of project as desired by inspection engineer, co-ordination of inspection agency of purchaser/consultant with his factory/sub-vendor's factory/erection site will be the sole responsibility of successful vendor after placement of order for complete air conditioning plant covered under these technical specifications.

6.0 Piping System

- 6.1 In general pressure tests shall be applied to piping only before connection of equipment and appliance. In no case shall piping, equipment or appliances be subjected to pressure exceeding their test ratings.
- 6.2 Tests shall be completed and approved before any insulation is applied.
- 6.3 After tests have been completed, the system shall be drained and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fittings, and debris.

7.0 Duct Work

- 7.1 All branches and outlets shall be tested for air quantity, and the total of the air quantities shall be within plus five percent (5%) of fan capacity.
- 7.2 Fire dampers, volume dampers and splitter dampers shall be tested for proper operation.

8.0 Balancing and Adjustment

All air handling ventilation equipment, duct work and outlets shall be adjusted and balanced to deliver the specified air quantities indicated, at each inlet and outlet, on the drawings. If these air quantities cannot be delivered without exceeding the speed range of the sheaves or the available horse power, the architect shall be notified before proceeding with the balancing of air distribution system.

9.0 Electrical Equipment

- 9.1 All electrical equipment shall be cleaned and adjusted on site before application of power.

- 9.2 The following tests shall be carried out :
- 9.2.1 Wire and cable continuity tests.
- 9.3 Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 volt meggar. The meggar reading shall be not less than one megohm.
- 9.4 Earth resistance between conduit system and earth must not exceed half (1/2) ohm.
- 9.5 Phasing out and phase rotation tests.
- 9.6 Operating tests on all protective relays to prove their correct operation before energising the main equipment.
- 9.7 Operating tests on all starters, circuit breakers, etc.

10.0 Performance Tests

- 10.1 The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the architects.
- 10.1.1 Air volume passing through each unit, duct, grilles, and apertures.
- 10.1.2 Differential pressure readings across each filter, fan and coil, and through each pump.
- 10.1.3 Static pressure in each air duct.
- 10.1.4 Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.
- 10.1.5 Continuous recording over a specified period, of ambient wet and dry bulb temperatures under varying degrees of internal heat loads and use and occupation, in each zone of each part of the building.
- 10.2 Daily records should be maintained of hourly readings, taken under varying degrees of internal heat load and use and occupation, of wet and dry bulb temperatures, upstream "on-coil" of each cooling coil. Also suction temperatures and pressures for each refrigerating unit. The current and voltage drawn by each machine.
- 10.3 Any other readings shall be taken which may subsequently be specified by the architect.

11.0 Miscellaneous

- 11.1 The above tests are mentioned herein for general guidance and information only but not by way of limitation to the provisions of conditions of contract and specification.
- 11.2 The date of commencement of all tests listed above shall be subject to the approval of the architect, and in accordance with the requirements of this specification.

- 11.3 The contractor shall supply the skilled staff and all necessary instruments and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system if the architect requests such a test for determining specified or guaranteed data as given in the specification or on the drawings.
- 11.4 Any damage resulting from the tests shall be repaired and/or damaged material replaced, all to the satisfaction of the architect.
- 11.5 In the event of any repair or any adjustment having to be made, other than normal running adjustment, the tests shall be void and shall be recommended after the adjustment or repairs have been completed.
- 11.6 The contractor must inform the architect when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present.
- 11.7 Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the architect.
- 11.8 The contractor may be required to repeat the test as required, should the ambient conditions at the time not given, in the opinion of the architect, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

MODE OF MEASUREMENTS

1.0 Unit Prices in the Schedule of Quantities

- 1.1 The item description in the schedule of quantities is in the form of a condensed resume. The unit price shall be held to include every thing necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.
- 1.2 The unit price of the various items shall include the following:
 - 1.2.1 All equipment, machinery, apparatus and materials required as well as the cost of any tests which the consultant may request in addition to the tests generally required to prove quality and performance of equipment.
 - 1.2.2 All the labour required to supply and install the complete installation in accordance with the specifications.
 - 1.2.3 Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the contractor to carry out his work.
 - 1.2.4 All the necessary measures to prevent the transmission of vibration.
 - 1.2.5 The necessary material to isolate equipment foundations from the building structure, wherever necessary.
 - 1.2.6 Storage and insurance of all equipment apparatus and materials.
- 1.3 The contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

2.0 Measurements of Sheet Metal Ducts, Grilles/Diffusers etc.

2.1 Sheet Metal Ducts

- 2.1.1 All duct measurements shall be taken as per actual outer duct surface area including bends, tees, reducers, collars, vanes & other fittings. Gaskets, nuts, bolts, vibration rotation pads are included in the basic duct items of the BOQ.
- 2.1.2 The unit of measurements shall be the finished sheet metal surface area in metres squares. No extra shall be allowed for lapse and wastages.
- 2.1.3 All the guide vanes, deflectors in duct elbows, branches, grille collars quadrant dampers etc. shall be measured for actual sheet metal surface and paid for at the same rate as duct of same thickness.

2.1.4 The unit duct price shall include all the duct hangers and supports, exposing of concrete reinforcement for supports and making good of the same as well as any materials and labour required to complete the duct frame.

2.2 Grilles/Diffusers

All grilles/diffusers as per tender requirements shall be treated as a lump sum item. Where extra grilles/diffusers are ordered upto award of work, they should be measured as follows:

2.2.1 All measurements of grilles/diffusers shall be the actual neck size excluding the outer flanges.

2.2.2 The square or rectangular grilles/diffusers shall be measured in plain sq.m.

2.2.3 All round diffusers shall be measured by their diameters in cm.

2.2.4 All linear diffusers shall be measured as per actual length in metres.

3.0 Measurements of Piping, Fittings, Valves, Fabricated Items

3.1 Pipe (Including water piping, steam piping, oil piping, lpg gas piping, air piping, vacuum piping) etc.

3.1.1 All pipes shall be measured in linear metre (to the nearest cm) along the axis of the pipes and rates shall be inclusive of all fittings e.g. tees, bends, reducers, elbows etc. deduction shall be made for valves in the line.

3.1.2 Exposing reinforcement in wall and ceiling and floors of possible and making good the same or installing anchor fasteners and inclusive of all items as specified in specifications and schedule of quantities.

3.1.3 Rates quoted shall be inclusive of providing and fixing vibration pads and wooden pieces, wherever specified or required by the project co-ordinator.

3.1.4 Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowance being made for providing the same.

3.1.5 The length of the pipe for the purpose of payment will be taken through the centreline of the pipe and all fittings (e.g. tees, bends, reducers, elbows, etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above for the fittings for valves and flanges, section 3.2 below applies.

3.2 Valves and Flanges

3.2.1 All the extra ci & cm flanged valves shall be measured according to the nominal size in mm and shall be measured by number. Such valves shall not be counted as part of pipe length hence deduction in pipe length will be made wherever valves occur.

3.2.2 All gun metal (gate & globe) valves shall include two Nos. of flanges and two numbers 150 mm long ms nipples, with one side threaded matching one of the valves, and other welded to the M.S. slip-on-flange. Rate shall also include the necessary number of bolts, nuts and washers, 3 mm thick insertion gasket of required temp. grade and all items specified in the specifications.

3.2.3 The rates quoted shall be inclusive of making connections to the equipment, tanks, pumps etc. and the connection made with an installed pipe line shall be included in the rates as per the B.O.Q.

3.3 **Structural Supports**

Structural supports including supports fabricated from pipe lengths for pipes shall be measured as part of pipe line and hence no separate payment will be made. Rates shall be inclusive of hoisting, cutting, jointing, welding, cutting of holes and chases in walls, slabs or floors, painting supports and other items as described in specifications, drawings and schedule of quantities or as required at site by project co-ordinator.

3.4 **Copper Connections for Fan Coil Units**

3.4.1 Copper connection assembly for making connections to the fan coil units shall be measured, as part of the fan coil unit price and shall include brass flare nuts, brass straight connector, brass tees, brass reducing fittings, fixing of automatic 3 way valve, making connections and leak testing, complete assembly as per specifications and drawings. Nothing extra shall be payable on account of any variation in the length of copper pipe.

4.0 **Insulation**

4.1 The measurement for vessels, piping, and ducts shall be made over the bare uninsulated surface area of the metal.

4.2 **Pipes, Ducts & Vessels**

4.2.1 **Pipes**

The measurements for installation of piping shall be made in linear metres through all valves, flanges, and fittings. Pipes/bends shall be measured along the centre line radius between tangent points. If the outer radius is r_1 and the inner radius is r_2 the centre line radius shall be measured as $(r_1+r_2)/2$. Measurement of all valves, flanges and fittings shall be measured with the running metre of pipe line as if they are also pipe lengths. Nothing extra over the above shall be payable for insulation over valves, flanges and fittings in pipe line/ routings. Fittings that connect two or more different sizes of pipe shall be measured.

4.2.2 **Ducts**

The measurements for insulation of ducts shall be made in actual square metres of bare uninsulated duct surface through all dampers, flanges and fittings. In case of

bends the area shall be worked out by taking an average of inner and outer lengths of the bends. Measurements for the dampers, flanges, fittings shall be for the surface dimension for the connecting duct, nothing extra over the above shall be payable for insulation over dampers, flanges and fittings in duct routing.

4.2.3 **Vessels**

The area of standard dished and flat ends of vessels shall be the square of the diameter of the uninsulated body of the shell. Areas for other shapes shall be the actual calculated area. There shall be no deduction or additions for nozzles, handles ribs, dampers, expansion joints etc. All projections on vessels or tanks shall be measured separately as pipe/duct.

4.3 **Accessories Insulation**

4.3.1 The unit of measurement for accessories such as expansion tank, pumps, chiller heads etc. shall be uninsulated are in square metres.

4.3.2 In case of curved or irregular surfaces, measurements shall be taken along the curves.

4.3.3 The unit insulation price shall include all necessary adhesives, vapour proofing and finishing materials as well as additional labour and material required for fixing the insulation.

4.4 **Acoustic Duct Lining**

4.4.1 In case of acoustic lining of air ducts, measurements of the bare inside duct surface in square metres shall be final for billing purposes.

4.4.2 The insulation/acoustic panels shall include cost of battens, supports, adhesives, vapour proofing, finished tiles/boards/sheets as well as additional labour and materials required for completing the work.

SCHEDULE OF EQUIPMENT

1. Air cooled Package type DX Units(indoor and outdoor unit)

a)	Capacity (TR)	15
b)	Qty (cfm)	3500
c)	No of rows of coil (Minimum)	6
d)	No. of fins/cm of coil	5

2. DUCTABLE SPILIT TYPE AIR CONDITIONER

a)	Capacity (TR)	17
b)	Air Qty (cfm)	6800
c)	No of rows of coil (Minimum)	4
d)	No. of fins/cm of coil	5

3. HIGH WALL SPLIT AIR CONDITIONER

a)	Capacity (tons)	1.5TR	2TR
b)	Air Qty (cfm)	600	800
c)	No of rows of coil (Minimum)	3	3
d)	No. of fins/cm of coil	5	5

4. WINDOW AIRCONDITIONER

a)	Capacity (tons)	1.5TR	2TR
b)	Air Qty (cfm)	600	800
c)	No of rows of coil (Minimum)	4	4
d)	No. of fins/cm of coil	5	5

Propeller Fan : GEC(Alsthom)/Crompton Greaves/ Khaitan/Usha/Polar

Axial Fan : Krugger/ Flakt/ Nicotra

Pipes

GI : ITC/ Jindal/Tata/SAIL/HSL

MS upto 150 mm dia : ITC/ Jindal/Tata/SAIL/HSL

MS 200 to 300 dia : ITC/ Jindal/Tata/SAIL/HSL

GI Sheets : TATA/SAIL/Jindal/Bhushan Steel

Aluminium Sheet : Balco/Nalco/Hindalco

Grilles/Diffusers : Ravistar/Caryaire/ Mapro/Dynacraft

Fire dampers (Motorized) : Caryaire/Dynacraft / Ravistar

Electric Hot Water Generator : Rapid cool/Emerald/Khokar

Valves

Gate Valve : Leader/Divine/Sant/Bankim Sarkar

Butterfly Valves : Advance/Castle/Audco/Intervall /Arrow/C&R

Balancing Valves : Advance/Castle/Audco/Arrow/C&R

Non-return Valves : Advance/Castle/Kirloskar/C&R/Arrow

Pot & Y- Strainer : Emerald/Sant/Rapid cool

Three way mixing valves : Staefa/Johnson/Honeywell/Danfoss/Anergy/Rapid controls

Two way motorized valve : Staefa/Johnson/Honeywell/Danfoss/Anergy /Rapid controls

Actuating motor for 3 way & 2 way valve : Staefa/Johnson/Honeywell/Danfoss/Anerg

Ball Valve with & without strainer : Rapid Control/Sant/Leader

Insulation

Fibre glass	:	FGP Ltd./UP Twiga/Kimmco / Owens Corning
Expanded Polystrene	:	Beardsell Ltd./ BASF/Styrene Packing/ Indian Packaging Industries/ Lloyd
Air Filters	:	Thermadyne/Klenzaid/Kirloskar /Anfilco/Johnflower/Dynafilter
Thermometers/Pressure Gauge	:	Fiebig/Emerald/H Guru/Japsin
Thermostats/Humidistats	:	Honeywell/Penn /Staefa/Johnson/ Anergy /Rapid Controls
Electric Strip Heaters	:	Escorts/Daspas
Controls	:	Honeywell/ Johnson / Staefa
Electric Panels	:	CPRI approved make (To be approved by HSCC)
Electric Motors	:	Siemens/ Kirloskar /ABB/ Bharat Bijlee/ Crompton Greaves
Starters/Contactors	:	L&T/ GE Power/ Siemens/ ABB
ACB/MCCB	:	L&T/ GE Power/ Siemens/ ABB
Switch Fuse/ Fuse Switch Units	:	L&T/ GE Power/ Siemens/ ABB
Cables		
Power Cables & Control cable	:	CCI/Universal/ICC/NICCO/INCAB/ National/ Rallison Cables
Lamps & Push Buttons Relays Current Transformer/ Ammeter/Voltmeter	:	L&T/GE/ Siemens/ Schneider

TECHNICAL SPECIFICATION OF OPERATION THEATRE (MAJOR) FOR CHATTISGARH

SCOPE OF WORK -

Supply construction, and commissioning of Operating Theatre (Major) in accordance with the specifications, bill of quantities and providing of free spare parts and service during 1 year Defect Liability Period.

1. CEILING SYSTEM

40 mm thick Double skin totally flush Walkable false ceiling panels made with 0.8 mm thick Galvanised Powder coated Skin Pass (GPSP) sheet on both side with $36 \pm 2 \text{ kg/m}^3$ density PUF as infill, with suitable Ceiling grid and supporting hardware. Joints shall be sealed with clean room compatible silicon sealant. Panel will be class "0", fire rated. Factory made cutout -12 Nos. (Approx.) in the ceiling panel for light fixture.

Laminar Flow Tent is to be made of 0.8mm thk SS-304 grade, no-4 finish sheet and provision for flanges for Duct connections and 6mm perforated grill. Size 8ft x 8ft x 700mm ht. (Duct connection and Diffusers/Dampers, filters if any required are in the scope of HVAC part) Tent will be made so as Laminar Flow System to integrate with OT equipments

2. WALL WITH CORNER COVING

Epoxy painting and Extruded aluminium powder coated/Anodized clip on type coverings for the entire wall to wall and wall to ceiling. R-70 , 3D internal/ external corner coves

3. SWING DOOR

44 mm thick doors made with Poly Urethane painted 0.8mm thick GPSP sheets on both sides with PUF as infill, 1.2 mm thick GPSP powder coated door frames totally flush with the wall panels, hardware like push plates, handles, door closure, double glazed view glass of std size, Stainless Steel Ball Bearing butt hinges and provision for concealed automatic door bottom Drop seal etc. Supply & Installation of double glazed view panels (1 Square ft. area) with flush design, with 6mm thick float glass fixed in double panel with necessary arrangements.

4. PERIPHERAL LIGHT

It should be fitted outside the air ceiling system area and flush with the ceiling in the operation theatre suitable to required illumination of OT. Peripheral lights and clean room luminaries fitted in the frame should be 12 in numbers for OT. The fluorescent lamps 54 W 16mm Ø- 3 nos with highly spectacular anodized Aluminum reflectors and optical antiglare system for adjustable light distribution. Luminaries cover made of highly resistant, disinfectant proof laminated safety glass with fine grained surface, glass pane with white powder coated steel frame. Luminary's body made of sheet steel, white, powder coated supplied ready for connection. The reflectors should be of high quality, cleanable and non deteriorating. Dimmable ballasts of reputed companies to be used and diffuser should be constructed with opaque acrylic diffuser material in aluminum frames/ SS frames. It should have flicker less design with color. Recess frames should be gas tight. The fitting should be flush with the ceiling and should be removable form top or bottom. Lighting units should be properly sealed with the ceiling by means of fillers and beadings so that all lighting units are airtight with ceiling panels. The light fitting should be uniformly and aesthetically distributed on the ceiling to provide uniform illumination in the OR. Peripheral lighting should be done according to IP65 protocol. Light should not interfere when green mode of Endoscopy is performed.

5. OT CONTROL PANEL

The room Surgeon's control panel should be designed to cope with changing technology & equipment in operating environments. Control Panel will be user friendly & ease of operating & maintaining purpose. The panel should be "Membrane" type; configured to incorporate all the services that operation room staff required. Operation Theatre Surgeon Control Panel consisting of display like Real time, Count down time, lighting control through dimmer, Telephone, Gas pressure set point, Alarm, Room Temperature and Relative Humidity mounted flush in the theatre wall with Distribution Board complete with all accessories etc. Lighting Control along with

- i. Day time clock -Digital
- ii. Elapsed Time Clock -Digital

The control panel should be user friendly and ease of operation and maintenance. All internal wires should be marked with plastic ferrule type cable markers, for ease of identification. The control panel should be able to be integrated with the commonly used OT software in future.

The control panel should meet Electrical Safety Code for High and Low voltage system, wired to the current IEE regulations.

6. X-RAY FILM VIEWER

The two (2)-plate viewing 3 pieces of high frequency fluorescent lamps X-Ray Viewing Screen should be designed to provide flicker free luminance for clear film viewing. Each plate should be able to illuminate films upto 14”x17” size. ‘Dimming is controlled using dimming ballast and PCB mounted inside the box. The mounting of the Screen should be installed flushed with Operation theatre wall to avoid dust accumulation and microbial growth and ease of cleaning. The diffuser should diffuse the light evenly and to provide adequate luminance for film viewing. Body should be of extruded aluminum powder coated black with bacteria and disinfectant resistant finish. Proper spring loaded film clip with rollers should be provided to holes of the films firmly and to remove the film without scratches. The X-Ray Film viewer should comply with relevant Electrical Safety Codes for High and Low voltage system.

7. WRITING BOARD

Writing Board as operating list Board of size-1000x700x60deep should be made of ceramic having magnetic properties and should be flushed to the wall of the operating Room.

8. BUILT-IN STORAGE UNIT

Storage Unit should be made out of 1.50 mm thick AISI-304 Stainless steel. The storage unit should be divided 2 or more parts and each part should have individual glass doors with high quality locking system. These doors should be installed on the storage units with the help of imported fittings allowing an opening allowance of 160degree. Each part should be provided with steel racks which should be completely detachable type. The storage unit should be fitted with 5mm thick vacuum insulated glass door and mounted flush with the theatre wall. The storage unit should be continuously ventilated by positive air in the OT through ventilation holes provided at the bottom and top of opposite sides. The dimensions of each storage unit should not be less than height 2100mm x width 1200mm x depth 350mm. The storage units should be designed in a way that they are flush with the OT wall panels and the units should be air tight, not allowing any leakage between units and the wall panels.

9. DISTRIBUTION BOARD & ELECTRICAL WIRING, CONDUITING WITH FIXTURES INSIDE THE OPERATION THEATRE

All high voltage equipment should be installed in a separate enclosure. Electric Distribution Panel, UPS, Transformers, Mains, Relays, Circuit protective equipment, for all circuits of Operation theatre shall be installed in the remote cabinet. All electrical wiring should be terminated to the connectors mounted on DIN/CE approved rail and labeled with indelible labels. Individual fuse and miniature circuit breakers should protect all internal circuits. Complete schematic diagram drawing description should be enclosed with the equipment.

Laying of PVC conduits, Modular Switch Boxes, Modular Switches-sockets, Power and Light wiring including Earthing wire for all the lighting controls, Pendant and other equipment fixtures and fittings inside the theatre Wiring with low leakage current wires of FRLS wires should be as per requirements. Wiring for 250 volts single phase and neutral 6/16 Amps switched socket outlet with 4 sq.mm and 2.5 sq.mm PVC insulated copper conductor 1100 volts stranded flexible wires should be concealed with conduit. Installation of all electrical cabling must be of IS: 1554 (As per latest amendment) standard and wiring as per IS: 732 standard and proper earthing of OT and other accessories in the OT room as per standard guidelines of BIS. Fittings should be sealed on accordance with the standard IP54. Earthed equipotent bonding of all exposed metal work should be provided.

10. OPERATION THEATRE FLOORING (ANTISTATIC CONDUCTIVE TILES)

A floor should be provided, flat to within a tolerance of +/- 3mm over any 3-metre area. Onto this sub floor, a self-leveling compound should be laid prior to laying of the floor finish. Copper grounding strips (not less than 0.05mm thick, 50mm width) should be laid flat on the floor in the conductive adhesive and connect to copper wire of grounding. The floor finish in the operating room should be 2mm Conductive PVC tiles, laid on a semi conductive adhesive base. The floor finish should terminate at the room perimeter passing over a concealed cove former and continuing up the wall for 100mm. All joints should be welded with electrodes of the same compatible material to provide a continuous sealed surface.

11. CEILING MOUNTED ANAESTHETIC PENDANT (SINGLE ARM)

1x Articulated Arm- 850 mm and 650 mm

1x Basic Console-600 mm-1 x Single Shelf 500 mm x 400mm x 80mm-2xIV Poles set (tube +4 bottle holding tube)

Provision of Outlets : 6 Nos. with Hose Assembly

Power Sockets : 8 Nos

Medical Rail –One Set

12. CEILING MOUNTED SURGEON PENDANT-(Double Arm) comprising of

1 x Articulated Arm-850 mm and 650mm

1x Basic Console-600 mm-1 x Single Shelf 500 mm x 400mm x 80mm

1 x Adjustable shelf (Hang on/Un hinge)

8 x Mains Socket (13A single)-

8 x Medical terminals & Hose Assembly

Medical Rail One Set

13. CEILING OT LIGHT – (LED)-IMPORTED

Description of Function

Dual Dome Surgical lights illuminate the surgical site for optimal visualization of small, low-contrast objects at varying depths in incisions and body cavities.

Operational Requirements

The light should comprise of 2 units, one major (diameter one minor (diameter around 55 cm). Each unit should have a central light around 90 cm) and bulb.

Should have a facility of continuous brightness adjustment.

Should be shadow free

Cables should be through the central supporting pillar of light. Each should have a single bulb with reserve.

Technical Specifications

The light should be easily maneuverable and should have a swivel radius of at least 150 cms and height adjustment of at least 100 cms

Each unit should provide more than 200000 lux light at 4200 k colour temperature

The optimum colour temperature of the light should be between 4200 –4700 kelvin, with colour rendering index of at least 90.

Each unit should provide a pre-focussed beam of light with at least 50 cms depth of field. It should be a cool light and should not interfere with the laminar air flow system. The absorption of infrared radiation should be more than 99% and infrared radiation to feet at 100000 lux should be less than 35 w per sq metre

Each unit should have halogen lamp of average life of 1000 hours 25 spare bulbs should be included

There should be reserve light source (halogen) with automatic activation in case of a fuse bulb

Should have option of electro magnetic brakes to maintain the light in a steady position

The light should have 360 degree turning radius with unbreakable head Glass.

Light should automatically switch on in case of resumption of electricity after power failure.

The handle should be Auto clavable & detachable.

Should have CE certification

System Configuration Accessories, spares and consumables

In addition to the above mentioned equipment/appliances, if the contractor thinks it necessary to include any other equipment/appliances, accessories etc. for the MGPS then that may be provided after approval from Engineer in-charge.

The sizes are approximate. Minor variations in sizes shall be acceptable subject to prior approval of the Engineer.

APPROVED MAKES

- | | | |
|----|---|--------------------|
| 1. | Ceiling System | MDD/MPS/Hi_Tek/MGI |
| 2. | Hermetically Sealed Swing door | MDD/MPS/Hi_Tek/MGI |
| 3. | Peripheral Light | Philips/Wipro |
| 4. | OT Control Panel | MDD/MPS/Hi_Tek/MGI |
| 5. | X-Ray Film Viewer | MDD/MPS/Hi_Tek/MGI |
| 6. | Writing Board | MDD/MPS/Hi_Tek/MGI |
| 7. | Built-in Storage Unit | MDD/MPS/Hi_Tek/MGI |
| 8. | Distribution board & electrical wiring, conduiting with fixtures inside the operation theatre | MDD/MPS/Hi_Tek/MGI |
| 9. | Antistatic Flooring | MDD/MPS/Hi_Tek/MGI |

10.	Pendant	MDD/MPS/Hi_Tek/MGI
11.	Cable	GLOSTER/UNIVERSAL/NATIONAL/ KALINGA
12.	Control Panel	L & T/ SIEMENS/ SCHNEIDER
13.	PVC Pipe Class III with Fitting	FINOLEX/ SUPREME/ PRINCE/ ORI-PLAST
14.	G.I. / M.S. Pipe Heavy Class	TATA/ JINDAL(HISSAR)/SAIL /SURYA PRAKASH
15.	MCCB/Contactor/Relay	L&T/ABB/SIEMENS/SCHNEIDER
16.	Pressure Gauges	H.GURU /FIEBIG
17.	Stainless Steel	TATA/SALEM/JINDAL/MUKUND/BHAYANDER/AMBICA
18.	Copper Pipe	MEHTA/PRECISION/RAJCO

Note:

- **All electrical accessories like cable wire, electrical outlets, switches etc, should be fire proof of reputed make, certified for electrical safety.**
- **Wherever makes have not been specified for certain items, the same shall be as per BIS and as per approval of HSCC.**
- **The contractor should provide test certificate for all material used for construction of pre-fabricated OT**
- **The contractor shall be responsible for the complete works including submission of working drawing and walk through view.**
- **The Contractor should provide complete parts manual/Service manuals for all systems and subsystems.**
- **Final electrical safety test, system test and calibration should be done by authorized person with test instruments.**
- **Training for seven working days should be provided to the staff & engineers of client by the Manufacturer**
- **The contractor should prepare and submit layout plan to HSCC for approval before beginning of supply and installation.**

TECHNICAL SPECIFICATION OF OPERATION THEATRE(MINOR) FOR CHATTISGARH

SCOPE OF WORK -

Supply construction, and commissioning of Operating Theatre (Minor) in accordance with the specifications, bill of quantities and providing of free spare parts and service during 1 year Defect Liability Period.

14. CEILING SYSTEM

40 mm thick Double skin totally flush Walkable false ceiling panels made with 0.8 mm thick Galvanised Powder coated Skin Pass (GPSP) sheet on both side with 36 ± 2 kg/m³ density PUF as infill, with suitable Ceiling grid and supporting hardware. Joints shall be sealed with clean room compatible silicon sealant. Panel will be class "0", fire rated. Factory made cutout -12 Nos. (Approx.) in the ceiling panel for light fixture

15. WALL WITH CORNER COVING

Epoxy painting and Extruded aluminium powder coated/Anodized clip on type covings for the entire wall to wall and wall to ceiling. R-70 , 3D internal/ external corner coves

16. SWING DOOR

44 mm thick doors made with Poly Urethane painted 0.8mm thick GPSP sheets on both sides with PUF as infill, 1.2 mm thick GPSP powder coated door frames totally flush with the wall panels, hardware like push plates, handles, door closure, double glazed view glass of std size, Stainless Steel Ball Bearing butt hinges and provision for concealed automatic door bottom Drop seal etc. Supply & Installation of double glazed view panels (1 Square ft. area) with flush design, with 6mm thick float glass fixed in double panel with necessary arrangements.

17. PERIPHERAL LIGHT

It should be fitted outside the air ceiling system area and flush with the ceiling in the operation theatre suitable to required illumination of OT. Peripheral lights and clean room luminaries fitted in the frame should be 12 in numbers for each OT. The fluorescent lamps 54 W 16mm Ø- 3 nos with highly spectacular anodized Aluminum reflectors and optical antiglare system for adjustable light distribution. Luminaries cover made of highly resistant, disinfectant proof laminated safety glass with fine grained surface, glass pane

with white powder coated steel frame. Luminary's body made of sheet steel, white, powder coated supplied ready for connection. The reflectors should be of high quality, cleanable and non deteriorating. Dimmable ballasts of reputed companies to be used and diffuser should be constructed with opaque acrylic diffuser material in aluminum frames/ SS frames. It should have flicker less design with color. Recess frames should be gas tight. The fitting should be flush with the ceiling and should be removable form top or bottom. Lighting units should be properly sealed with the ceiling by means of fillers and beadings so that all lighting units are airtight with ceiling panels. The light fitting should be uniformly and aesthetically distributed on the ceiling to provide uniform illumination in the OR. Peripheral lighting should be done according to IP65 protocol. Light should not interfere when green mode of Endoscopy is performed.

18. X-RAY FILM VIEWER

The two (2)-plate viewing 3 pieces of high frequency fluorescent lamps X-Ray Viewing Screen should be designed to provide flicker free luminance for clear film viewing. Each plate should be able to illuminate films upto 14"x17" size. 'Dimming is controlled using dimming ballast and PCB mounted inside the box. The mounting of the Screen should be installed flushed with Operation theatre wall to avoid dust accumulation and microbial growth and ease of cleaning. The diffuser should diffuse the light evenly and to provide adequate luminance for film viewing. Body should be of extruded aluminum powder coated black with bacteria and disinfectant resistant finish. Proper spring loaded film clip with rollers should be provided to hold the films firmly and to remove the film without scratches. The X-Ray Film viewer should comply with relevant Electrical Safety Codes for High and Low voltage system.

19. BUILT-IN STORAGE UNIT

Storage Unit should be made out of 1.50 mm thick AISI-304 Stainless steel. The storage unit should be divided 2 or more parts and each part should have individual glass doors with high quality locking system. These doors should be installed on the storage units with the help of imported fittings allowing an opening allowance of 160degree. Each part should be provided with steel racks which should be completely detachable type. The storage unit should be fitted with 5mm thick vacuum insulated glass door and mounted flush with the theatre wall. The storage unit should be continuously ventilated by positive air in the OT through ventilation holes provided at the bottom and top of opposite sides. The dimensions of each storage unit should not be less than height 2100mm x width 1200mm x depth 350mm. The storage units should be designed in a way that they are flush

with the OT wall panels and the units should be air tight, not allowing any leakage between units and the wall panels.

20. DISTRIBUTION BOARD & ELECTRICAL WIRING, CONDUITING WITH FIXTURES INSIDE THE OPERATION THEATRE

Electrical Distribution Board along with all high voltage equipment should be installed in a separate enclosure. Electric Distribution Panel, UPS, Transformers, Mains, Relays, Circuit protective equipment, for all circuits of Operation theatre shall be installed in the remote cabinet. All electrical wiring should be terminated to the connectors mounted on DIN/CE approved rail and labeled with indelible labels. Individual fuse and miniature circuit breakers should protect all internal circuits. Complete schematic diagram drawing description should be enclosed with the equipment.

Laying of PVC conduits, Modular Switch Boxes, Modular Switches-sockets, Power and Light wiring including Earthing wire for all the lighting controls, Pendant and other equipment fixtures and fittings inside the theatre Wiring with low leakage current wires of FRLS wires should be as per requirements. Wiring for 250 volts single phase and neutral 6/16 Amps switched socket outlet with 4 sq.mm and 2.5 sq.mm PVC insulated copper conductor 1100 volts stranded flexible wires should be concealed with conduit. Installation of all electrical cabling must be of IS: 1554 (As per latest amendment) standard and wiring as per IS: 732 standard and proper earthing of OT and other accessories in the OT room as per standard guidelines of BIS. Fittings should be sealed on accordance with the standard IP54. Earthed equipotent bonding of all exposed metal work should be provided.

21. OPERATION THEATRE FLOORING (ANTISTATIC CONDUCTIVE TILES)

A floor should be provided, flat to within a tolerance of +/- 3mm over any 3-metre area. Onto this sub floor, a self-leveling compound should be laid prior to laying of the floor finish.

Copper grounding strips (not less than 0.05mm thick, 50mm width) should be laid flat on the floor in the conductive adhesive and connect to copper wire of grounding. The floor finish in the operating room should be 2mm Conductive PVC tiles, laid on a semi conductive adhesive base. The floor finish should terminate at the room perimeter passing over a concealed cove former and continuing up the wall for 100mm. All joints should be welded with electrodes of the same compatible material to provide a continuous sealed surface.

22. Minor OT Light Ceiling –HALOGEN

The unit should have reflector for optimum utilization of the dual reflector by means of targeted light direction technique with following specifications:

- Power supply : 230V, 50/60Hz
- Colour Temp. : 4200K
- Light intensity at 0.8m distance : 40000-45000lux
- Light field diameter : 180-200mm
- Colour rendering index Ra(1-8)-93
- Luminous efficacy in the light field : 290lm/w or more
- Power consumption : 12V/50W
- Working space : 27-173cm
- Lifetime of bulb : Atleast 2000hrs.
- Swivel radius : 960mm
- Vertical adjustment : 1250mm
- Weight : 20 kg.
- Should have CE certification for electricity safety

In addition to the above mentioned equipment/appliances, if the contractor thinks it necessary to include any other equipment/appliances, accessories etc. for the MGPS then that may be provided after approval from Engineer in-charge.

The sizes are approximate. Minor variations in sizes shall be acceptable subject to prior approval of the Engineer.

APPROVED MAKES

1.	Ceiling System	MDD/MPS/Hi_Tek/MGI
2.	Swing door	MDD/MPS/Hi_Tek/MGI
3.	Peripheral Light	Philips/Wipro
5.	X-Ray Film Viewer	MDD/MPS/Hi_Tek/MGI
6.	Writing Board	MDD/MPS/Hi_Tek/MGI
7.	Built-in Storage Unit	MDD/MPS/Hi_Tek/MGI
11.	Distribution board &	MDD/MPS/Hi_Tek/MGI

	electrical wiring, conduiting with fixtures inside the operation theatre	
12.	Antistatic Flooring	MDD/MPS/Hi_Tek/MGI
13.	Ceiling OT Light	PHILIPS/UNITED SURGICAL/MAGNATEK/SURGITECH
12.	Cable	GLOSTER/UNIVERSAL/NATIONAL/ KALINGA
13.	Control Panel	L & T/ SIEMENS/ SCHNEIDER
14.	PVC Pipe Class III with Fitting	FINOLEX/ SUPREME/ PRINCE/ ORI-PLAST
15.	G.I. / M.S. Pipe Heavy Class	TATA/ JINDAL(HISSAR)/SAIL /SURYA PRAKASH
16.	MCCB/Contactor/Relay	L&T/ABB/SIEMENS/SCHNEIDER
17.	Pressure Gauges	H.GURU /FIEBIG
18.	Stainless Steel	TATA/SALEM/JINDAL/MUKUND/BHAYANDER/AMBICA

Note:

- **All electrical accessories like cable wire, electrical outlets, switches etc, should be fire proof of reputed make, certified for electrical safety.**
- **Wherever makes have not been specified for certain items, the same shall be as per BIS and as per approval of HSCC.**
- **The contractor should provide test certificate for all material used for construction of pre-fabricated OT**
- **The contractor shall be responsible for the complete works including submission of working drawing and walk through view.**
- **The Contractor should provide complete parts manual/Service manuals for all systems and subsystems.**
- **Final electrical safety test, system test and calibration should be done by authorized person with test instruments.**
- **Training for seven working days should be provided to the staff & engineers of client by the Manufacturer**
- **The contractor should prepare and submit layout plan to HSCC for approval before beginning of supply and installation.**