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CIVIL / STRUCTURAL WORKS

TECHNICAL SPECIFICATIONS - CIVIL WORKS

1. INTRODUCTION

The "Assam Health System Strengthening Project" has been formulated, which aims to improve the situations and strengthen the functions of medical institutions focusing on tertiary hospitals which are core medical centers to create an environment where residents in Assam state can access equally to necessary medical services.

The project aims to develop:

- **6 Super-specialty Wings** at 6 Medical Colleges
- **2 District Hospitals and**
- A Dedicated **Training, Monitoring, and Administrative Centre Swasthya Bhawan** located in Guwahati

This contract encompasses the construction of 2 District Hospitals at Silchar and Udalguri, and allied buildings within the campuses of each district hoapitals respectively. The project will involve comprehensive Civil, MEP (Mechanical, Electrical, and Plumbing) works, as well as External Development Works. This initiative falls under the Assam Health System Strengthening Project, supported by the Japanese Infrastructure Cooperation Agency (JICA).

The targeted clinical departments of 150 Bedded District hospital and Emergency Centre includes:

- General Medicine
- General Surgery
- Obstetrics & Gynecology
- Pediatrics,
- Ophtalmology
- ENT
- Orthopaedics,
- Psychiatry
- Dental
- Emergency

1.1. DESIGN BASIS:

The Hospital has been designed to provide tertiary healthcare facilities meeting the patient's needs and comfort. Some significant concepts that have been incorporated while designing and planning are listed below:

- Smooth horizontal and vertical movement of patients, staff and visitors. All the departments are inter-linked for horizontal and vertical circulations.
- Various small waiting spaces have been dedicated for Patient and people near each department apart from common waiting areas as this will help in decongestion in peak period.

- Smooth accessibility for the differently-abled persons.
- Natural light to all the patient rooms has been externally provided.
- Centralized air conditioning, firefighting and detection system
- Planning and allocation of services as per the National Building Code-2016 and applicable bye-laws
- Provision of solar water heating system

Hospital Block Planning (Floor-wise Departments) :

General

- The District hospital building of all three location are mentioned below:-
  1. S.M. Dev Hospital - Silchar : - G+5 storey structure.
  2. Udalguri : - G+4 storey structure.
- The hospital block has Three entry points namely OPD, Emergency, staff & services.
- All the entries on ground floor are well connected to lift lobby and staircase nearby for easy and convenient access for one and all to various departments on upper floors.
- The main/visitor entry corridor further leads into sizeable registration cum waiting area with registration counters and patient waiting.

Service Blocks/ Facilities:

Service Blocks with adequate space like Electrical Substations, AHU rooms at Terrace, ETP, STP, UGT , BMW has been planned.

Medical Services:-

- Adequate Space provision has been made for Morgue room, Kitchen Room & MGPS room & CSSD inside / outside of the Hospital buildings

Waste Disposal Facility:-

Adequate space has been planned for collection of solid waste. Also separate dedicated space has been planned for collection of Bio Medical waste generated from Hospital buildings.

External Development

Site Levels:

The proposed level of internal roads and Building Plinths has been provided based on the existing access road in front of the site and HFL data recevied from concern depratment. the Finished ground levels and building levels are given in site layout plan

HFL Data Received from Water resource department Silchar :-

OFFICE OF THE
EXECUTIVE ENGINEER, CACHAR W. R. DIVN., W. R. DEPTT., SILCHAR

No. TB/W/373/2014-15/49/208 Date : 22/05/2024.

To
The Superintendent
S.M. Dev Civil Hospital , Silchar

Sub : Regarding flood level records along with the HFL of the Barak River of Cachar District for last ten years.
Ref : Your letter No. SMDCH/Corres./07/2023-24/1335 Dt.16/05/2024

Sir,

With reference to the subject cited above , I am herewith furnishing the Hydrological data pertaining to Cachar Water Resources Division , Silchar from the year 1998 to 2023 as per your requirement.

Enclo : As above.

Yours faithfully,

Executive Engineer,
Cachar W. R. Division, Silchar.

HYDROLOGICAL DATA

Maximum Rainfall = 4753mm (2010) Average Rainfall = 3400mm
Highest Water Level = 21.84m on 01-08-1989 at A. P. Ghat, Silchar

Year	Bank at Annapurnaghat	Rukni at Dholai	Sonalal S. M. Road	Total Rainfall at D&D Colony, Silchar
DL	19.83m	21.58m	21.385m	
1998	20.65m on 10-06-1998 at 0800 hrs.	22.20m on 13-08-1998 at 0900 hrs.	23.265m on 09-08-1998 at 1600 hrs.	3473.90mm

Circulation & Parking

The circulation and parking has been planned to keep the pedestrian character of the complex. The open parking has been carefully disguise and softens through vegetation or totally screened off with trees/ shrubs.

Road

The proposed construction includes 80mm paver roads for the main driveway, encompassing the parking areas. Pedestrian footpaths has been constructed with cement concrete and chequered tiles. The service entry area will feature 60mm thick paver blocks, while the ambulance parking and emergency entry ramp has been paved with cement concrete.

Landscape

Main objective of the landscape theme is to create a pleasant outdoor environmental for the patients and visitors to this prestigious complex, complementary to the character of the built form. The aim of the landscape theme is to create an enabling healing environment for the patients.

Irrigation to the plantation shall be done with the combination of modern irrigation techniques and manual irrigation methods, in line with the site conditions and local agro-climatic conditions and assist in conserving the landscapes besides saving water and ecology.

Compound Wall & Fencing

On the main entrance side, the compound wall feature a AAC wall with a grill design. The internal boundary wall has been constructed using a AAC wall with GI chain link fencing.

Signages

- Exterior signage will be mounted on the wall using an MS framework. The signage itself will consist of an MS pipe frame, clad with 3mm aluminum composite panels cut by CNC router. The letters will be laser-cut from 10mm clear cast acrylic, set into a cut-out fitted on 4mm 040 cast acrylic. The front of the letters will feature 3M day and night electrocut vinyl. The signage will be illuminated with backlit LED lights.
- The internal signage for Main Directory, Floor Directory, Floor Plate, and Canteen is made from 10mm casted clear acrylic sheets, laser-cut for precision. The text, all 2mm thick acrylic, is also laser-cut, partially housed and adhered onto the engraved surface of the clear acrylic base. The 10mm acrylic sheet is affixed to 25x25mm teak wood sections using crafted stainless steel pins, and then further secured to the prescribed locations with wooden dowels.

- A 1mm rigid PVC sheet containing Lumingen 3 as a base chemical, designed for high-intensity photo luminescent glow, intended for use in radiation rooms.
- Elevator signage is provided using 1.5mm polished 304 grade stainless steel plates, duly etched and filled with prescribed enamel colors to display an elevator disclaimer, sized 250x250mm.
- The prohibition signs should be made of cast acrylic with laser-cut text and images. They should be fixed using stainless steel fittings according to the design.

1.2.SCOPE OF WORK:

The work should be carried out in accordance with the Detailed project Report, Architectural drawings and structural drawings (proof checked/vetted by the IIT), MEP and allied services drawings and approved by the PWD, Assam. The Technical Specifications are to be read with and in general conforming to the Latest CPWD Specifications.

Contractor(s) shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work. All such reference points shall be in relation to the levels and locations, given in the Architectural and plumbing drawings. On completion of work, the Contractor(s) shall submit required number of prints of “as built” drawings to the Engineer-in-Charge.

Before commencement of any item of work the Contractor shall correlate all the relevant architectural, structural, MEP and other service drawings, and specifications etc. and satisfy himself that the information available is complete and unambiguous. The Contractor alone shall be responsible for any loss or damage occurring by the commencement of work based on any erroneous and or incomplete information and no claim whatsoever shall be entertained on this account.

The Contractor shall give performance test of the entire installation(s) as per the specifications in the presence of the The Engineeror his authorized representative before the work is finally accepted and nothing extra what-so-ever shall be payable to the Contractor for the test.

The work of services will be executed simultaneously. The Contractor shall minimize the scope of making recesses, holes, opening etc. as the same shall be planned in advance and necessary grooves/niches shall be provided in shuttering of RCC.

Sample of building materials, fittings and other articles required for execution of work shall require prior approved from the The Engineerbefore use in the work. The quality of samples brought by the Contractor shall be judged by standards laid down in the relevant CPWD/ BIS specifications. All materials and articles brought by the Contractor to the site for use shall conform to the samples approved by the The Engineerwhich shall be preserved till the completion of the work.

BIS/IS marked materials except otherwise specified shall be subjected to quality test at the discretion of the The Engineerbesides testing of other materials as per the specifications described for the item/material. Wherever BIS marked materials are brought to the site of work, the Contractor shall, if required, by the Engineer-in-Charge, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the material / procured by the Contractor for incorporation in the work satisfies the provisions of specifications / BIS codes relevant to the material and / or the work done.

The Contractor shall procure the required materials in advance so that there is sufficient time to testing of the materials and clearance of the same before use in the work. The Contractor shall provide at his own cost suitable weighing and measuring arrangements at site for checking the weight / dimensions as may be necessary for execution of work.

Contractor shall submit minimum "Quality Assurance" plan which shall consist of:

a. Lot size, number of required tests and frequency of testing. While deciding these criteria CPWD Specifications & provisions of BIS Code and standard practices may be referred. The mandatory test shall be in conformity with the requirements details in the latest CPWD specifications. For testing of other materials/work, the requirements as per provisions of BIS Code and standard practices shall be applicable.

b. It should clearly indicate the Machinery and other Tool & Plants required to be deployed at site by the Contractor. Entire Machinery and T&P may not be required at the start of work, therefore, a proper time schedule by which each Machinery & T&P is to be brought at site should also be indicated.

c. The Contractor shall maintain record of Receipt of Materials, testing of the same & Maintenance of Register of Tests.

d. All the registers of tests carried out at Construction Site or in outside laboratories shall be maintained by the Contractor, which may be inspected by The Engineeror his/her designee at any point of time.

e. The Contractor shall allow access to Project Management Consultant(PMC)/ Third Party Quality Assurance Agency (TPQAA) engaged by PWD-Assam/PMU-AHIDMS/PMC to have a control on quality and methodology of execution. Requisite number of Samples of materials including Cement Concrete Cubes shall be taken jointly by Contractor, PMC/TPQAA and The Engineeror their authorized representative. All arrangements for transporting and getting them tested shall be made by the Contractor.

f. All the test in field lab setup at Construction Site shall be carried out by the Quality control team to be engaged by the Contractor which can be witnessed by The Engineer or his/her designee. A daily report of Tests to be conducted on a day shall be submitted to The Engineeror his authorized representative.

g. All the entries in the registers will be made by the designated Engineering

Staff of the Contractor.

h. The Contractor shall be responsible for safe custody of all the test registers.

i. Submission of copy of all test registers, Material at Site Register and hindrance register along with each alternate Running Account Bill and Final Bill shall be mandatory.

j. All material received at site shall be entered in MAS Register and copy of Supply order, MTC & Bill-invoice shall be maintained in order. The MAS Registers including Cement and Steel Registers shall be maintained by a qualified staff of Contractor which may be inspected by The Engineeror his authorized representative at any time. The daily report of receipt of material shall be sent to The Engineeror his authorized representative.

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

Pour Card, Check-List for Execution of Work:

i. As and when any important item is taken up for execution, the Contractor shall submit the specifications and develop a checklist and Pour card. This sample checklist should be prior-approved from the The Engineerand should be used at site. This check list should be shown to the The Engineeror his authorized representative or PMC during inspection. This procedure is to be followed for all hidden items, CC/RCC work, Steel- reinforcement, shuttering, cast-in-situ mosaic flooring, doors & windows, plumbing, including water supply pipe lines, roof treatment, earth filling etc.

ii. The Contractor shall render all help and assistance in documenting the total sequence of this project by way of photography, slides, audio-video recording etc. nothing extra shall be payable to the Contractor on this account.

Shop Drawings:

Necessary approvals have to be obtained for specialized item of works such as following shop drawings:

i. Structural Glazing/ Aluminum/ Dry Partition,
ii. Potable pump installation drawing
iii. Fire Pump installation drawing
iv. Lift
v. Electrical Panels,
vi. Electrical panel (HT/LT)

vii. SLD
viii. DG Set
ix. Transformer,
x. Street Light / High Mast
xi. HVAC System,
xii. STP,
xiii. ETP
xiv. WTP
xv. Furniture etc.

Detailed shop drawings including drawings required for statutory approval like Fire Department, Electrical & Pollution Control Board etc., have to be prepared by the approved vendor, based on the GFC drawings issued by the Competent Authority.

However it is responsibility of the vendor to Design Specialized foundation for the vendor works based on the relevant codes.

Satutory Approval:

The scope of work includes liaisoning & Obtaining mandatory approvals (Pre & Post Construction)from all local bodies/ State & Central authorities/ Municipal Corporation, forest clearance, NOC from Fire Department, NOC from Airport Authority of India, BSNL/MTNL, Central Electricity authority, Muncipal Authority, Water supply & sewerage authorities, EIA, CPCB, CGWB / State Water Board, Approvals as per latest Assam local building Byelaws / Town & Country Planning (Assam) Bye laws with up to date corrections slips, etc. and any other statutory approval/Central Licensing Approving Authority etc. related to super speciality Hospital, approval from authorities required for commencing the work, execution of work & services and handing over the assets. The statutory payments to these agencies will be paid by the agency except the charges of Electrical Service connection from local supply agency to the energy meter in the premises of the building which will be initially paid by the contractor and reimbursed by the department to the contractor on producing the proof of charges paid to the local concern agency.

2. TECHNICAL SPECIFICATION - CIVIL

2.1.EARTH WORK:

Excavation (in surface excavation, over area, foundation, trenches etc.) in all kind of soil shall be carried out upto desired level as per structural drawings. However, care shall be taken to ensure to support the footings on firm strata as per minimum SBC specified in structural drawings. The foundation level shown in the structural & architectural drawings are for supporting the foundation on firm strata as per SBC specified therein. The minimum depth of foundation shall be 3m with respect to existing ground level at particular location. However, care shall be taken to ensure to support the footings on firm strata as per minimum SBC specified in structural drawings. The mandatory tests required in accordance with IS 10042 need to be carried out during construction by the Contractor. Subsurface conditions

encountered during construction may vary somewhat from the conditions encountered during site investigation. There is likelihood of encountering localized clay seams in the type of formation that exists at site. Therefore, it is essential to examine the founding levels very carefully during excavation and remove the same if met with till firm strata is ensured prior to laying of PCC. It should be ensured that at foundation level, no voids are there, if voids are observed the same shall be grouted. Necessary soil stabilization measures shall be implemented by the Contractor to achieve the bearing capacity as specified in structural drawings. Any deviation in earth work, concrete work, RCC work, or any other items of works will be ignored and nothing extra shall be paid on account of varying foundation level (in order to ensure supporting of foundation on firm strata and at minimum SBC specified in structural drawings). The Contractor shall quote the rate accordingly. Earth required for filling in all works like trenches, foundations, Plinth, around building, road work and other development works shall be of good quality useful for filling as per CPWD specifications. The available excavated earth suitable for filling shall be used by the Contractor. Excess earth required if any shall be procured from outside the campus for which nothing extra shall be paid. Surplus excavated earth after filling as per site conditions to be disposed outside the campus by taking required permission from concerned Government authority. No extra payment will be made for the above. All the excavated earth/soil shall be Levelled & neatly dressed.

Dewatering:

For works below ground level the contractor shall keep the area free from water. Subsoil water level shall be maintained at least 50cm below the P.C.C level, till the laying of water proofing treatment over PCC, laying of basement raft and retaining wall & filling of earth/sand under the basement floor & behind retaining wall. If dewatering or bailing out of water/rain water is required, the contractor shall do the same at his own cost until completion of outer retaining wall, water proofing of vertical surfaces of retaining walls and back filling behind the walls upto ground level.

De-watering required, if any, shall be done confirming to BIS Code IS: 9759 (guide lines for de-watering during construction) and / or as per the scheme / specifications approved by the Engineer-in-Charge. Design of an appropriate and suitable dewatering system shall be the Contractor's responsibility. Such scheme shall be modified / augmented as the work proceeds based on fresh information discovered during the progress of work, at no extra cost. At all times during the construction work, efficient drainage of the site shall be carried out by the Contractor and especially during the laying of plain cement concrete, taking levels etc. If needed, suitable precautionary measures shall be taken by the Contractor.

Nothing extra shall be payable on this account.

(i) Dewatering shall be carried out by suitable means with adequate stand-by arrangements and the disposal of water shall be done as per the direction of the Engineer-in-charge.

(ii) The subsoil water from dewatering may be required to be connected to the raw water grid in the area for use in horticultural purpose or contractor will make his own arrangement for disposal of sub soil water, if any approval from local body is required the contractor

will get the same for which no extra payment will be made. However, only the cost of providing and laying pipe line beyond site boundary shall be paid.

(iii)In trenches where surface water is likely to get into cut / trench during monsoons, a ring bund of puddle clay or by any other means shall be formed outside, to the required height, and maintained by the Contractor. Also, suitable steps shall be taken by the Contractor to prevent back flow of pumped water into the trench. Nothing extra shall be payable on this account.

(iv)The safety& stability of adjacent structure and roads etc. shall be ensured during entire period of construction.

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

Method of Measurement and Payment

Payment for all Earth work shall be made on the basis of volume arrived at by measuring the length, breadth and depth.

Rate:

The rate shall include for all materials, labour charges, multiple handling transportation, lead, lift, all taxes, hire of tools and plants, testing to the satisfaction of the The Engineeretc. complete for the finished Work.

2.2.SAND FILLING:

Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading zone IV or V specified in Section 3 ‘Mortars’. Sand filling shall be done in a manner similar to earth filling in plinth that consolidation shall be done by flooding with water. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered till the The Engineerhas inspected and approved the sand filling.

Method of Measurement and Payment

Payment for sand filling work shall be made on the basis of volume arrived at by measuring the length, breadth and depth.

Rate:

The rate shall include for all materials, labour charges, multiple handling transportation, lead, lift, all taxes, hire of tools and plants, testing to the satisfaction of the The Engineeretc. complete for the finished Work.

2.3. SHORING AND STRUTTING:

When the depth of trench in soft/loose soil exceeds 2 metres, stepping, sloping and/ or shoring and strutting of sides shall be done. In case of loose and slushy soils, the depths at which these precautions are to be taken, shall be determined by the The Engineeraccording to the nature of soil. Shoring and strutting shall be 'close' or 'open' depending on the nature of soil and the depth of trench. The type of Shoring and strutting shall be determined by the Engineer-in-Charge. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of trenches from collapse. The Engineershould take guidance from IS: 3764 for designing the shoring and strutting arrangements and specifying the profile of excavation. Close Shoring and Strutting Close Shoring and strutting shall be done by completely covering the sides of the trench generally with short upright, members called 'poling boards'. These shall be 250x38 mm in section or as directed by the Engineer-in-Charge. The boards shall generally be placed in position vertically in pairs. One boards on either side of cutting. These shall be kept apart by horizontal wallings of strong wood at a maximum spacing of 1.2 metres cross strutted with ballies, or as directed by Engineer-in-Charge. The length and diameter of the ballies strut shall depend upon the width of the trench. Where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical 'wallings' which shall be strutted to similar timber pieces on the opposite face of the trench. The lowest boards supporting the sides shall be taken in the ground for a minimum depth of 75 mm. No portion of the vertical side of the trench shall remain exposed. The withdrawal of the timber members shall be done very carefully to prevent collapse of the trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged while removing the planks. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried, unless required by the Engineer-in- Charge to be left permanently in position.

Open Shoring And Strutting:

In case of open Shoring and strutting, the entire surface of the side of the trench is not required to be covered. The vertical boards 250 mm wide & 38 mm thick, shall be spaced sufficiency apart to leave unsupported strips of 50 cm average width. The detailed arrangement, sizes of the timber and the distance apart shall be subject to the approval of the Engineer-in- Charge. In all other respect, specifications for close Shoring and strutting shall apply to open Shoring and strutting.

Method of Measurement and Payment

Payment for Shoring and Strutting Work shall be made on the basis of area arrived at by measuring the length and depth.

Rate:

The rate shall include for all materials, labour charges, multiple handling transportation, lead,

lift, all taxes, hire of tools and plants, testing to the satisfaction of the Engineer incharge etc complete for the finished Work.

2.4. BORED CAST-IN-SITU REINFORCED CONCRETE PILES

General

The piles are formed within the ground by excavating or boring a pile within it with or without the use of temporary casing and subsequently filling it with plain or reinforced concrete. When the casing is left permanently it is termed as cased pile and when the casing is taken out it is termed as uncased pile.

Equipment: The equipment and accessories used for bored cast-in-situ piles shall depend on subsoil strata, ground water conditions, type of founding material and penetration etc.

The equipment is applicable for bored piles without the use of bentonite.

Boring operation shall be done by rotary percussion type drilling rigs using direct mud circulation or reverse mud circulation methods to bail out the cuttings or as specified. In soft clays and loose sand, bailer and chisel method should be used with caution to avoid the effect of suction. Rope operated grabbing tool Kelly mounted hydraulically operated grab are also used. This method of advancing the hole avoids suction. The size of cutting tool shall be as per [IS 2911 (Part I Section 2)] and not less than the diameter of pile by more than 75 mm.

Permanent casing where specified shall be used to avoid aggressive action of water. Boring for installing Pile

Installation of Piles : Installation of piles shall be as accurate as possible and as per design and drawings. The vertically or the required batter should be correctly maintained. Particular care shall be taken in respect of installing either single pile or piles in two pile groups.

(i) Deviation and Tolerance : The deviation/tolerance should be as per IS 2911 (Part 1/Sec.1). The piles should not deviate more than 75 mm or D/4 whichever is less (75 mm or D/10 whichever is more in case of piles having diameter more than 600 mm) from their designed position at the working level.

(ii) In case of a single pile under a column, the positional deviation should not be more than 50 mm or D/4 whichever is less (100 mm in case of piles having diameter more than 600 mm. Greater tolerance may be prescribed for piles driven over water and for raking piles.

Procedure of Driving Pile Bore

(i) Bored cast-in-situ concrete piles are installed by making a bore into the ground and removing out the material.

(ii) The ground shall be roughly leveled and position of pile marked. The boring shall be done with or without the use of temporary casing. The sides of bore

hole; shall be stabilized with the aid of temporary casing or with the aid of drilling mud of suitable consistency.

(iii) The equipment and accessories shall depend upon the type of bored pile chosen for the job, consideration of sub-soil strata, ground water condition, type of founding material. Boring operation normally are done by rotary or percussion type drilling rigs using direct mud circulation on reverse mud tool shall be as detailed in IS 2911 (Part 1/Sec.2).

(iv) In case permanent/temporary casing is not used then bored pile is stablised with drilling fluid. Bentonite supplied to site shall conform to IS 2720 (Part V). A certificate shall be obtained by the Contractor from the manufacturer showing properties of each consignment and should be submitted to the Engineer-in-charge. Bentonite shall be mixed thoroughly with fresh clean water to make a suspension which will maintain the stability of the pile excavation for the period necessary to place concrete and complete construction. The temperature of the water used in mixing the bentonite suspension and when supplied to bore hole shall not be lower than 5ºC. Consistency of the drilling fluid suspension and when controlled throughout the boring as well as in concreting operations in order to keep the hole stabilized as well as to avoid concrete getting mixed up with thick suspension of mud.

Frequency and methods of testing drilling fluid shall be as specified and the test results shall be as specified in IS 2720 (Part V).

(v) Bored cast-in-situ piles in soils which are stable may often be installed with a small casing length at the top. A minimum of 2.0 m length of top of bore shall; invariably be provided with casing to ensure against loose soil falling in to drilling mud, or a suitable steel casing. The casing may be left in place permanently especially in cases where the aggressive action of the ground water is to be avoided, or in the cases of piles built in water or in cases where significant length of piles could be exposed due to scour.

(vi) For bored cast-in-situ piles, casing/liner shall be driven open ended with a pile driving hammer capable of achieving penetration of the liner to the length shown on the drawing or as directed by the Engineer-in-charge. Materials inside the casing shall be removed progressively by air lift, grap or percussion equipment or other approved means.

(vii) Where bored cast-in-situ piles are used in soils liable to inflow, the bottom of the casing shall be kept low enough in advance of the boring tool; to prevent the entry of soil into the casing, thus presenting the formation of settlements in the adjoining ground. The water level in the casing should generally be maintained at the natural ground water level for the same reasons. The joints of the casing shall be made as tight as possible to minimize inflow of water or leakage of slurry during concreting.

(viii) Boring shall be carried out using rotary or percussion type equipment. Unless otherwise directed by the The Engineerthe diameter of the bore holes shall be not more than the inside diameter of the liner.

(ix) After the boring has reached the required depth, the steel reinforcement shall be lowered in position maintaining the specified size of cover on all sides. The bore shall then be flushed with bentonite slurry and concreting shall be taken up exactly as described under clause 20.1.6.8 (IS 2911).

A proper record of pile driving and other details such as sequence of installation of piles, dimension of piles, depth bored, time taken for concreting etc. shall be maintained in sequence of occurrence at site as per clause 20.1.3.6. (IS 2911)

While drilling mud is used, the specific gravity of fresh supply and contaminated mud in the hole before concreting is taken up shall be recorded for first ten piles and subsequently at interval of 10 piles or as specified.

Sl.No.	IS No.	Subject
1.	IS-1200 (Part 23)	Method of measurement of building and Civil Engineering Works – Piling.
2	IS-2911 (Part 1/Sec. 2)	Code of practice of Design and Construction of pile foundation. Bored Cast-in-situ piles.
3	IS-2911 (Part 3)	Code of practice for Design and Construction of pile foundation. Under reamed piles.
4	IS-2911 (Part 4)	Code of practice for design and Construction of pile foundation. Load test on piles.
5	IS-5112	Safety Code for piling and other deep foundations.
6	IS-6426	Specification for pile driving hammer.
7.	IS-6427	Glossary of terms relating to pile driving.
8.	IS-6428	Specification for pile frame.
9.	IS-9716	Guide for lateral dynamic load test on piles.
10.	IS-14362	Pile boring equipments. General requirements.

Reinforcement:

(i) The design of reinforcing cage varies depending upon the driving and installation conditions, the nature of the sub-soil and the nature of load to be transmitted by the shaft, axial or otherwise. The minimum area of longitudinal reinforcement of any type or grade within the pile shaft shall be 0.4 per cent of the sectional area calculated on the basis of the outside area of the casings of the shaft.

(ii) The curtailment of reinforcement along the depth of the pile, in general,

depends on the type of loading and sub-soil strata. In case of piles subjected to compressive load only, the designed quantity of reinforcement may be curtailed at appropriate level according to design requirements. For piles subjected to uplift load, lateral load & moments, separately or with compressive loads, it may be necessary to provide reinforcement to the full depth of the pile. In soft clays or loose sands, or where there is likelihood of danger to green concrete due to driving of adjacent piles, the reinforcement should be provided up to full pile depth, regardless of whether or not it is required from uplift & lateral load considerations. However, in all cases, the minimum reinforcement specified in Para (i) above should be provided in full length of the pile.

(iii) Piles shall always be reinforced with a minimum amount of reinforcement as dowels keeping the minimum bond length into the pile shaft below its cut-off level, and with adequate projection into the pile cap, irrespective of design requirements.

Note: In some cases the cage may lift at bottom or at the laps during withdrawal of casing. This can be minimized by making the reinforcement "U" shaped at the bottom and up to well secured joints. Also the lifting 5 percent of the length should be considered not to affect the quality of pile.

(iv) Clear cover to all main reinforcement in pile shaft shall be not less than 50 mm and shall be maintained by suitable spacers. The laterals of reinforcing cage may be in the form of links or spirals. The diameter and spacing of the same is chosen to impart adequate rigidity of the reinforcing cage during the handing and installation. The minimum diameter of links or spirals shall be 6 mm and the spacing of the links or spirals shall be not less than 150 mm. The minimum clear distance between two adjacent main reinforcement should normally be 100 mm for full depth of the cage.

(v) The reinforcing cage should be left with adequate protruding length above the cut off level for proper embedment in the pile cap. Prior to the lowering of reinforcement cage into the pile shaft, the shaft shall be cleaned of all loose materials.

(vi) Reinforcement in the form of cage shall be assembled with additional support, such as spreader forks and lacings; necessary to form a rigid cage hoops, links, or helical reinforcement has to fit closely around the main longitudinal bars and shall be tied by binding wire of approved quality. The ends of the binding wire shall be turned into the interior of the pile. Reinforcement shall be placed and maintained in correct position. The reinforcements shall be joined wherever necessary by welding and the procedure of welding be followed as described in IS 2751.

Concrete

Cement : Cement shall be as specified in agreement item or as specified under sub- head 3.0

of CPWD Specifications. However, high alumina cement shall not be used.

Water: Water to be used for concreting shall be as specified under sub-head 3.0 of CPWD Specifications.

Fine Aggregate: Fine aggregate to be used for concreting shall be as specified under sub- head 3.0 of CPWD Specifications.

Coarse Aggregate: For tremie concreting, coarse aggregate having nominal size more than 20 mm should not be used. Natural rounded shingle of appropriate size may also be used as coarse aggregate. It helps to give high slump with less water cement ratio.

Chemical Admixtures: Admixtures to be used in the concrete shall be as per IS 9103.

Concrete Grades to be adopted

(i) Concreting of piles shall be done only with design mix of appropriate grade with weigh batching of constituents. The grade of concrete to be kept as per nomenclature of the item.

(ii) Only concrete Grade M-30 and/or higher grades shall be used for concreting the piles. The exact grade of concrete to be used shall mainly depend upon the nature of work and the general design consideration. However, Concrete Grade M-15 and Grade M-20 shall not be used for concreting piles under any circumstances, even with weigh batching. The minimum cement content shall be 400 kg/m3 in all conditions.

(iii) When concreting under water or drilling mud 10 per cent additional cement over the minimum cement content for the particular grade shall be used subject to a minimum cement content of 370 kg/cum.

Workability of Concrete: The minimum slump shall be 100 mm when the concrete for the piles is being vibrated and when the concrete is not vibrated the maximum permitted slump is 150 mm. The degree of workability in both the cases is considered as very high.

Placing of Concrete

(i) Before commencement of pouring of concrete, it shall be ensured that there is no ingress of water in the casing tubes from bottom. Further, adequate control during withdrawal of the casing tube is essential so as to maintain sufficient head of concrete inside the casing tube at all stages of withdrawal.

(ii) Wherever practicable concrete should be placed in a clean dry hole where concrete is placed in dry hole and when casing is present, the top 3 m pile shall be compacted using internal vibrators. The concrete should invariably be poured through a tremie, with a funnel so that the flow is directed and concrete can be deposited in the hole without segregation. Care shall be taken

during concreting to prevent as far as possible the segregation of the ingredients. The displacement or distortion of reinforcement during concreting and also while extracting the tube shall be avoided.

(iii) Where the casing is withdrawn from cohesive soils for the formation of cast-in-situ pile, the concreting should be done with necessary precautions to minimize the softening of the soil by excess water. Where mud flow conditions exist, the casing of cast-in-situ piles shall not be allowed to be withdrawn.

(iv) The concrete shall be self compacting and shall not get mixed with soil, excess water, or other extraneous matter. Special care shall be taken in silt clays and other soils with tendency to squeeze into newly deposited concrete and cause necking. Sufficient head of green concrete shall be maintained to prevent inflow of soil or wager into concrete. The placing of concrete shall be continuous process from the toe level to the top of pile to prevent segregation, a tube of tremie pipe ass appropriate shall be used to place concrete in all piles. To ensure compaction by hydraulic static heads, rate of placing concrete in the pile shaft shall not be less than 6 m (length of pile) per hour.

(v) The diameter of the finished pile shall not be less than specified and a continuous record shall be kept by the Engineer as to the volume of concrete placed in relation to the length of pile cast. After each pile has been cast and any empty pile hole remaining shall be protected and back filled as soon as possible with approved material.

(vi) The minimum embedment of cast-in-situ concrete piles into pile cap shall be 50 mm. Any defective concrete at the head of the completed pile shall be cut away and made good with new concrete. The clear cover between the bottom reinforcement in pile cap from top of pile shall not be less than 30 mm. The reinforcement in the pile shall be exposed for full anchorage length to permit it to be adequately bonded into the pile cap. Exposing such length shall be done carefully to avoid damaging the rest of the pile. In cases where the pile cap is to be laid on ground a leveling course with cement concrete of 1:4:8 and of 100 mm thickness shall be provided.

(vii) Normally concreting of piles should be uninterrupted. In exceptional case of interruption of concreting, but which can be resumed within 1 or 2 hours, the tremie shall not be taken out of the concrete. Instead it shall be raised and lowered slowly from time to time to prevent the concrete around the pipe from setting. Concreting should be resumed by introducing a little richer concrete with a slump of about 200 mm for each displacement of the partly set concrete. If the concreting cannot be resumed before final set of concrete already laid, the pile so cast may be rejected.

(viii) In case of withdrawal of tremie out of concrete, either accidentally or to removed a choke in the tremie, the tremie may be re-introduced to prevent

impregnation of laitance scum lying on the top of the concrete already deposited in the bore. The tremie shall be gently lowered on to the old concrete with very little penetration initially. A vermiculite plug should be introduced in the tremie. Fresh concrete of slump between 150 mm and 175 mm should be filled in the tremie which will push the plug forward and swill emerges out of the tremie displacing the laitance/scum. The tremie will be pushed further in steps masking fresh concrete sweep away laitance scum in its way. When the tremie is buried by about 60 to 100 cms, concreting may be resumed.

(ix) The top of concrete in a pile shall be brought above the cut-off level to permit removal of all laitance and weak concrete before capping and to ensure good concrete at the cut-off level for proper embedment into the pile cap.

(x) Where cut-off level is less than 1.5 metres below the working level concrete shall be cast to a minimum of 300 mm above cut-off level. For each additional 0.3 m increase in cut-off level below the working level additional coverage of 50 mm minimum shall be allowed. Higher allowance may be necessary depending on the length of the pile. When concrete is placed by tremie method concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection or to a minimum of one metre above cut off level. In the circumstances where cut-off level is below ground water level the need to maintain pressure on the unset concrete equal to or greater than water pressure should be observed and accordingly length of extra concrete above cut-off level shall be determined.

Placing Concrete under Water

(i) Before concreting under water, the bottom of the hole shall be cleared of drilling mud and all soft loose materials very carefully. In case a hole is bored with use of drilling mud, concreting should not be taken up when the specific gravity of bottom slurry is more than 1.2. The drilling mud should be maintained at 1.5 m above the ground water level. Concreting under water for cast-in- situ concrete piles may be done either with the use of tremie method or by the use of approved method specialty designed to permit under water placement of concrete. General requirements and precautions for concreting under water are as follows:

(a) The concreting of pile must be completed in one continuous operation. Also for bored holes, the finishing of the bore, cleaning of the bore, lowering of reinforcement cage and concreting of pile for full length must be accomplished in one continuous operation without any stoppage.

(b) The concrete should be coherent, rich in cement with high slump & restricted water cement ratio.

(c) The tremie pipe will have to be large enough with due regard to the size of the aggregate. For 30 mm aggregate the tremie pipe should be of diameter not less

than 150 mm and for larger aggregate, larger diameter of tremie pipe may be necessary.

(d) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it to prevent mixing of water and concrete.

(e) The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal if the pipe is surged to discharge the concrete.

(f) The pile should be concentrated wholly by tremie and the method of deposition should not be changed part way up the pile to prevent the laitance from being entrapped within the pile.

(g) All tremie tubes should be scrupulously cleaned after use.

When concreting is carried out under water a temporary casing should be installed to the full depth of the bore hole or 2 m into non collapsible stratum, so that fragments of ground cannot drop from the sides of the hole into the concrete as it is placed. The temporary casing may not be required except near the top when concreting under drilling mud.

Ready Mix Concrete

Alternatively, the Contractor can be allowed to use Ready Mix Concrete (RMC) with the permission of Engineer-in-Charge, provided that the manufacturer assures that for RMC supplied for the particular work contains the minimum cement content and it is in conformity of approved design mix. The manufacturer of RMC has also to agree to the sampling and testing procedure as specified under clause 20.1.7 of relevant IS. or alternatively he can propose his own sampling and testing procedure which should in turn be approved by the Engineer-in-Charge. Normally, RMC supplied to site are mixed with certain admixtures which enables the concrete to be used within 3 hours of supply at site. In case RMC supplied is not consumed within 3 hours of supply the quantity of RMC remaining unused beyond 3 hours shall be rejected and removed from site.

Important Note:

The number of piles can be finalized only after the completion of the intitial pile load test as per IS—2911 Part-4

The Pile design is based on Empirical formula and necessary revisions will be made after verification of load carrying capacity test as per 2911-Part 4 and results should be submitted for verification.

A) Vertical load carrying capacity of Pile in CPRF:

- The ultimate capacity of the piles is used in CPRF design.
- The ultimate load carrying capacity of 750mm diameter pile for a length of

20m is 230 Ton (taken for CPRF design)

B) Field test for combined pile raft foundation(CPRF):

The relevant test required at field level ,for the combined pile raft foundation (CPRF) with respect to the geotechnical engineering aspects should be carried out by the contractor as per the direction of the Engineer.

The protocols of the acceptance procedure and the measured values have to be included into the examination, the following aspects shall be considered in field.

1. Load Value: The piles must sustain a load of 230 tonnes during the initial load test.The load-settlement behavior and the load transfer within a CPRF should be monitored by a geotechnical engineer.
2. Settlement Criterion: The settlement of the piles under this load should not exceed 30mm.
3. The load is increased gradually until reaching the specified test load of 230 tonnes.

2.4.1 Measurement

Dimensions shall be measured nearest to a cm. Measurement of length on completion shall be along the axis of pile and shall be measured up to the bottom of pile cap. No allowance shall be made for bulking, shrinkage, cut off tolerance, wastage and hiring of tools, equipment for excavating, driving etc.

2.4.2 Rate

The rate includes the cost of material and labour involved in all the operations described above including pile embedded in pile cap except reinforcement, pile cap and grade beam

2.4.3 Water Pressure Relief Pipe

HDPE 100mm diameter pipe shall be provided at RCC base raft slab to a spacing of 4m c/c and rigidly fixed with raft reinforcement. The spacing and height of pressure relief pipe shall be varies at time of execution and water pressure test.

The pipe shall extend at bottom of PCC leveling coarse below raft slab. Filter media 40 mm size aggregate shall be provided at each pressure relief pipe lower end portion below PCC as sepcificed in drawing and engineer's direction. And the pipe shall be inserted into the (Filter madia). After completion of entire work the pipe hole shall be sealed / grouted with high strength micro silica concrete.

2.5. STONE COLUMN

Scope of Work:

This specification lays down the provisions for carrying out Ground improvement using vibro-floated Stone Column.
By stone column treatment, the non-plastic soils will be compacted for the following requirement:

- Making the soil Dense and mitigating the Liquefiable nature of the Soil ground
- Ground improvement to improve in-situ soil safe bearing capacity
- Ground improvement to limit settlement values as required for foundation design conditions.

The Stone Columns shall be executed by Vibro-displacement method and it shall be by dry bottom feed method or Wet Top feed method.

This specification lays down the requirements, methods and tests used / employed during the execution of the stone columns by wet bottom feed process.

The Contractor shall submit the detailed specification for the items not covered in this specification for approval by PMC/The Engineer during execution.

Conflicts & Deviations
If conflicting statements exist within this document or between this document and other applicable specifications, Standard Drawings, Industry standards, codes, etc., it shall be brought to The Engineer / PMC notice for clarification and proper approval shall be obtained before implementation. Decision of The Engineer / PMC shall be final.

Applicable Codes

The relevant Indian codes, standards and specifications which are to be referred shall be the latest edition including all applicable official amendments and revisions.

- IS 15284 (Part 1):Code of practice for Design and Construction for Ground Improvement
- BS EN 14731:2005: Execution of special geotechnical works – Ground treatment by deep vibration.
- IS: 3764: Safety code for Excavation Work.
- IS: 1892 : Code of practice for Subsurface Investigation for foundations
- IS: 2386 (Part IV): Method of Test for Aggregates for concrete – Mechanical Properties.
- IS: 383: Specification for coarse and fine aggregates from Natural Sources.
- IS 15284 (Part 1): Code of practice for Design and Construction for Ground

Improvement

- BRE 391 – 2000: Specifying vibro stone columns.
- IS 1893 - 2016: Criteria for earthquake resistant design of structures

Ground Preparation

The area where stone columns need to be executed shall be levelled / graded by filling / cutting the earth until the cut-off level required for the Stone Columns. Wherever filling is performed for grading purposes, the same shall be performed in layers of maximum 150 mm and compaction shall be performed to 95% dry density.

Installation of Stone Columns

Stone columns of required diameter shall be installed as per the procedure given below and as per the details and layout / construction drawing, by Vibro-floatation technique. Length of stone column from cut-off level shall be as per the Geotechnical Investigation Report and / or the Construction Drawings. The Stone columns shall be terminated in the firm stiff clay or medium dense sand with a minimum 500 mm embedment within this layer or as specified in the Soil report / Tender guide drawings / approved construction drawing. The termination depth for each zone shall be certified by the Engineer-in-Charge. The Termination Criteria defined here is generally opted. However, the same shall be re -established as per the Soil Conditions or the Geotechnical Investigation Report.

a) A borehole shall be formed at the location of stone column using vibro-float down to the required depth. The vibro-float shall be of adequate capacity to install stone columns as per the specified termination criteria and to achieve required compaction. Compaction criteria shall be established during installation of test stone columns.

b) After reaching the required depth, the borehole shall be filled with well graded angular stones from 50mm to 75mm down 8mm sieve. The individual particles of Stone aggregates shall conform to IS: 383 and should be clean, chemically inert, hard and resistant to breakage. All relevant tests (e.g., grain size, crushing value, impact value and abrasion value, etc) shall be carried out as per IS: 383 and results shall be furnished to The Engineerfor approval. The amount of charge fills to be placed at one time shall be restricted, so that the compacted column of not more than 1m height is formed at a time.

c) The vibro-float shall be withdrawn slowly in stages while compacting the granular fill. The compacting energy shall be adequate to form minimum the required diameter compacted stone column.

d) The process shall be repeated till the stone column is formed until the cut-off level.

e) Contractor shall maintain the records of the data as specified below for all test /

working stone columns.

i) Overall depth of stone column and of embedment in firm stiff stratum.

ii) Total and average quantity of backfill material per linear metre of the column.

iii) Total time required to complete one stone column.

f) The depth of stone column remaining un-compacted immediately below the cut-off level due to lack of adequate confining pressure, close to the top, shall be informed by the Contractor. A vibratory roller or any other mode of compaction shall be indicated by the Contractor. The compaction of the loose depth shall correspond to 85% minimum relative density or its equivalent.

g) The empty boring portion above stone column cutoff level up to working platform level shall be backfilled with stone/sand.

h) Cut off-level

The cut off level shall be as per GFC drawings with provision for 500mm granular blanket layer

i) Depth of Treatment

Depth of liquefiable depth shall be assessed based on the individual boreholes within proposed structures and geotechnical recommendations. However, the general guideline for depth of treatment shall be considered up to a SPT, N value of 25 or equivalent Qc for sandy soils.

j) Termination Criteria

Termination shall be as per Approved GFC drawings. In case of refusal at early or extending to deeper layers the Contractor shall take approval from the The Engineer by submitting necessary construction records.

Granular Blanket (Stone Sand Blanket)

The treated area shall be cleared off muck and any undulation will be filled with sand and compacted to get a finish grade level surface up to the cut-off elevation of Stone Columns over which the granular blanket shall be constructed.

Granular blanket shall be laid over the top of stone column for minimum of 500mm thickness or as per the governing design criteria where raft foundation directly resting on stone columns.

The granular blanket shall be compacted to a relative dry density of 85 percent. Compaction shall be carried out with rollers or by any other suitable mechanical equipment. Granular blanket shall be laid in layers of 150mm and compacted to achieve desired compaction. The Stone Sand Blanket shall be constructed with mixture of 75 mm and down stone aggregates and well graded medium to coarse sand of Fineness Modulus not less than 2.2. The proportions for mix ratio of 2:1 (2 Stone Aggregates: 1 sand).

Percentage fines (silt & clay) shall be limited to less than 5% and shall be free of vegetation.

Sequence of Works (Stone Columns and RCC Piling Works Integration)

Stone columns shall be performed before piling works. Integrated Layout of stone columns with RCC piling works shall be arranged so as to leave space for RCC Piling works. Stone columns layout shall consider soil condition, depth of stone columns required for liquefaction mitigation, Piling Layout.

Integrity of pile: Extreme care and caution should be taken to integrate the stone columns within the pile grids. The design of stone columns in terms of their arrangement and efficacy, when embedded in between the pile grids, should be thoroughly checked and the integrity of the RC pile shall never be affected in the process.

Ground Improvement

The treated ground should satisfy the following requirements:

- Spacing of stone columns and depth shall be arrived based on the pile layout drawings/ shallow foundations.
- Liquefiable layers shall be considered as per Borehole details.
- The factor of safety against liquefaction shall be more than 1 after ground improvement.
- The allowable bearing capacity and settlement for raft shall be satisfied.

The ground improvement including improvement in SBC, reduction in settlement and liquefaction mitigation after construction shall be verified by reputed agency such as IIT/NIT through relevant field test. All the cost for field verification and charges payable to IIT/NIT shall be bound by the contractor.

Requirements of field verification

Geotechnical report giving information on soil profile is attached with this tender document for guidance purpose. It reveals presence of entrapped liquefiable layers of soil which vary in location and thickness. If necessary, the Contractor will carry out additional geotechnical investigation at his own cost to firmly establish soil parameters, especially presence of liquefiable layers. If there are any major design variations, PMC will review the soil profile and design details before starting the execution of work.

1) For mitigation of soil liquefaction potential

The diameter and spacing of stone columns should be adequate to densify the liquefiable layer around pile in case of pile foundations with sufficient measure to convert it into non liquefiable layer. The target N (penetration) value to be reached in order to cross this

threshold shall be derived for each liquefiable layer shall be derived using the methodology given in IS 1893 Part 1:2016.

The number of stone columns should be adequate to reach the target N value.

a) The internal spacing as well as extent of stone columns beyond periphery of pile group in case of pile foundation and periphery of footings in case of open foundations shall be sufficient to satisfactorily cover zone of influence all around.

b) Besides mitigation of liquefaction around local foundations, ground improvement by stone columns shall address overall stability of structure under seismic condition in terms of overall and differential settlement due to liquefaction.

2) For improvement in net safe bearing capacity

a) The diameter and spacing of stone columns should be adequate to densify the soil below the footings in sufficient measure to achieve net safe bearing capacity as specified on the drawings.

b) The internal spacing as well as extent of stone columns beyond periphery of footings shall be sufficient to satisfactorily cover zone of influence (i.e. pressure bulb) all around.

c) The internal spacing as well as extent of stone columns beyond periphery of footings shall be sufficient to limit both overall and differential settlement to allowable values as per IS code.

d) Ground improvement by stone columns shall be such as to provide overall stability of structure for under all applicable combinations of loads.

Field verification of SBC, Settlement and Liquefaction mitigation

During the initial stone column plate load test carried out as per IS 15284 part 1, if the test results do not match with the design requirements in terms of SBC, settlement and liquefaction mitigation necessary design revision will be carried out by PMC and revised GFC drawings will be issued. Nothing extra will be paid in account of any revision made by PMC.

Submittals

Before commencement of the work, the Contractor shall submit to the The Engineer for his approval for construction methodology, quality control procedure, method statement, procedure for carrying out initial & routine load test and post construction monitoring procedure after stone column and piles.

After completion of works at site, the Contractor shall submit complete test reports that include summary of drilling records, and other relevant information.

Records

The following details shall be recorded during the Stone Column execution works and shall

be submitted to Engineer-in-charge:

Inspection & Test Plan

- Request for Inspection
- Setting out Co-ordinates
- Material testing
- Measurement of Ground Level
- Daily Progress record for Ground Improvement
- Plate load test/ eCPT on Improved Ground
- Load Increment Chart
- Field Record For Plate Load Test/ eCPT
- Reaction and measuring gauge details

Post Treatment Performance Tests

a. **For Liquefaction Assessment post ground improvement**

i. Electric Cone Penetration Tests (eCPT) (or SPT) shall be carried out to check the efficacy of the ground improvement methods.

ii. Frequency: One eCPT (or SPT) shall be conducted for every 625 Sq.m of structure footprint area or minimum one number for each structure.

For SBC & Settlement assessment

i. Initial & Routine Single and Group column load tests shall be carried out as per the procedure outlined in IS 15284 – Part 1.

ii. Frequency for Routine Load Tests:
One load test shall be carried out for every 625 Sq.m of structure footprint area or minimum one number for every structure

Suitable Measures and additional improvement methods shall be considered by contractor wherever load test are not qualified.

b. **Test note for mitigation of soil liquefaction potential**

The achievement of targeted N value after carrying out ground improvement shall be confirmed by carrying out cone penetration test for each liquefiable layer in numbers as directed. If N value is found to be less than the targeted value, the Contractor shall carry out additional measures without extra cost to achieve the targeted value.

Test note for improvement in net safe bearing capacity

The Contractor shall carry out vertical load test as per specification to confirm achievement of required net safe bearing capacity after carrying out ground improvement at the location and in numbers as directed.

Load Tests On Trial Stone Columns

The following Specifications shall be followed while performing the required tests on the Trial Stone Piles

a) Load tests shall be performed on the trial stone columns at the test site to evaluate the load settlement behavior of the stone columns. These shall be conducted on single as well as on a group of three columns. Minimum of seven columns for single column test and fifteen columns for a three-column group test shall be constructed in a Triangular pattern. In case of Square Pattern, Minimum of nine columns for single column test and sixteen columns for a three-column group test shall be constructed. These are the minimum recommendations for the number of Test Columns. However, the same shall be established as per the area of improvement, soil conditions and design requirements.

b) The load test site shall be closer to critical loading locations as far as possible.

c) A granular blanket of, minimum 500 mm thick shall be spread over the test area before the commencement of the load tests. The blanket shall be compacted to a relative density of 85%.

d) The diameter of the reinforced concrete footing / Steel plate shall be equal to the spacing of stone columns in the case of a single column test with the center of the concrete footing/steel plate coinciding with the center of the stone column.

e) In the case of a three column test the diameter of the concrete footing / steel plate shall be 1.81 times the spacing of the columns with its center coinciding with the center of area of the three columns laid in a triangular pattern.

f) If the area is waterlogged, the water level shall be maintained at the concrete footing base level throughout the tests by dewatering. However, care shall be taken to prevent drawing out of water by centering the blanket or the subsoil.

g) Application of Load and Settlement considerations:

   1) The load shall be applied to the concrete footing by a suitable reaction loading taking care to avoid impact, fluctuations or eccentricity. The Contractor shall submit a schematic diagram showing the arrangement of loading & procedure for testing for approval.

   2) The settlement shall be recorded by four dial gauges fixed at diametrically opposite ends of the plate / footing having sensitivity of 0.02mm.

   3) The Kent ledge weight should be such that it can safely ensure application

of a test load. Minimum Kent ledge weight shall be 1.25 times the test load and shall be indicated by the Contractor. However, safe and efficient working of the loading arrangement is entirely the Contractor's responsibility and an impediment resulting in failure of the test arrangement may debar the Contractor from payment for the test. Alternatively, it may make the Contractor liable to repeat the test on a fresh series of columns without any extra payment to the Contractor for the stone columns.

4) Each stage of loading shall be 1/10 of the design load and it shall be maintained till the settlement rate is less than 0.05mm/hr. The next stage of loading shall be applied only after approval of the Engineer. The maximum test load shall be established by the Soil Specialist as per the design requirements.

5) The design load shall be maintained for a minimum period of 48hrs after the settlement have acquired the desired settlement rate. The maintenance period may be increased if the Engineer finds evidence of continual large cumulative settlements with the sustained design load.

6) Settlement may be observed for each increment of load at intervals of 1, 2, 4, 8, 15, 30 and 60 minutes, 1 ½hrs, 2hrs, 4hrs, and so on till the desired rate of settlement has been achieved. These intervals, if required, may be modified after mutual discussions depending upon the test observations.

7) Load versus time settlement graphs for each stage of loading shall be plotted and approval shall be taken from the Engineer-In-Charge. The settlements occurring at the design load shall be clearly indicated on the load-settlement graph.

8) The performance of the test columns shall be approved by the Engineer - in-charge based on the field loading tests by the following criteria:

   - 10mm to 12mm settlement at the design load for a single column test.

   - 20mm to 30mm settlement at the design load for a three-column group test.

9) This is the general recommendation. However, this criterion shall be established by the Geo- Technical Specialist as per the Soil Conditions and Design Requirements.

10) The maximum test load shall be removed in five stages. Each un-loading stage shall be maintained till stabilization of settlements has taken place. Settlements shall be recorded at each stage as per para 6 above and load versus settlement graph shall be plotted as per para 7 above.

Load Tests On Working Stone Columns

In order to ascertain the quality of job columns, a few single column tests shall be performed on the working columns depending upon the discretion of the Engineer-in-charge. The Contractor shall take necessary rectification measures like installation of additional columns, without any extra cost, if the working columns fail to meet the above performance criteria.

Sketches showing Stone column arrangement

- ANNEXURE I - Sample Load Test Plans for Single / Group of Stone Columns (1 Sheet)
- ANNEXURE II- Sample Schematic Diagram of Standpipe (Casagrande) Piezometer (1 Sheet)

Schedule

The Contractor shall complete the work as per the Time Schedule. The Contractor shall clearly mention the time frame / duration required for each of the above activities including initial, routine test, duration of stone column, piles and stone sand blanket etc,

Quality Assurance:

Contractor shall provide respective method statement and Quality Control Plans (QCP) following the material specifications and other project specifications. Quality Control Plan are to be get approved by the Engineer In duly before commencing of the work. Compliance of QCP does not relieve the Contractor from overall responsibility to render best quality of materials and work in conformity with all relevant specifications and best engineering practices.

The Contractor shall intimate about the selection of a Quality inspection agency or laboratory for acceptance test, sampling, material testing etc., to perform field quality assurance. The Contractor shall submit laboratory and onsite tests results to The Engineer & PMC approval.

The Contractor shall intimate about the selection of a Quality inspection agency or laboratory for acceptance test, sampling, material testing etc., to perform field quality assurance. The Contractor shall submit laboratory and onsite tests results to The Engineer & PMC approval.

Stone Columns shall be carried out by approved execution procedures. The Contractor shall employ sufficient of experience personnel who are familiar with the Stone Columns execution described in this specification.

IMPORTANT NOTE:

- A qualified Geotechnical engineer with minimum of 10 years relevant experience in ground improvement works, he/ she should be appointed by the contractor during the execution of stone columns and piling works. The

geotechnical engineer CV should be approved by PMC/ The Engineer

- ❖ All the field tests including intial load tests, routine load tests etc., should be carried out through a reputed agency (contractor), which needs to be approved by IIT/NIT, including the testing procedure and the test results. The test needs to be jointly witnessed by the representative of The Engineer and an authorized representative of IIT/NIT.

FIELD TEST:

Initial Load Test:

Stone columns will be tested by

1. For the ultimate load capacity of stone column
   (or)
2. At least 1.5 times the design load.

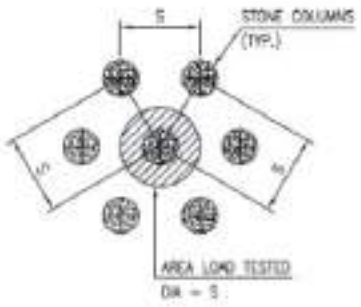
Importance of Load Testing:

1. Select a representative stone column for testing.
2. Apply load in increments as specified in the code.
3. To validate the load carrying capacity calculations
4. Measure settlement corresponding to each load increment.
5. Plot load-settlement curve and compare with design expectations.

B) Routine Load Test:

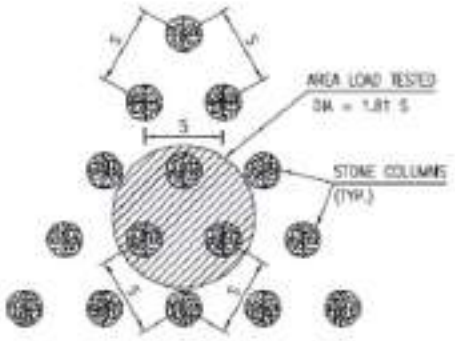
The stone columns will undergo routine load testing with loads up to 1.1 times the safe load.

Annexure – 1



LOAD TEST ON A SINGLE STONE COLUMN

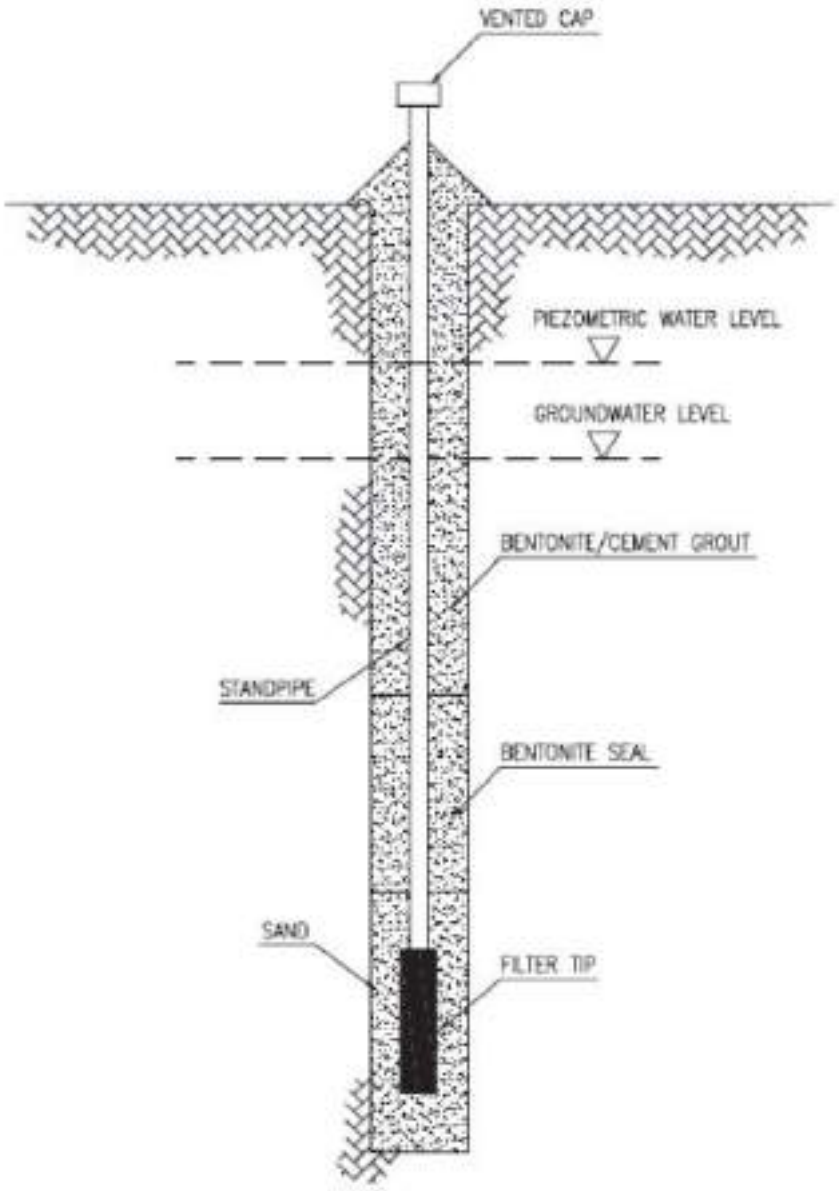
NOTE:-
1. S = SPACING OF STONE COLUMNS IN TRIANGULAR GRID PATTERN (1.8m).



LOAD TEST ON A GROUP OF THREE STONE COLUMNS

NOTE:-
1. S = SPACING OF STONE COLUMNS IN TRIANGULAR GRID PATTERN (1.8m).

Annexure II



STANDPIPE (CASAGRANDE) PIEZOMETER

2.6. CONCRETE WORKS:

All concrete works shall be carried out in general as per CPWD Specifications 2019, Volume-I & II with up to date revisions/ amendments / correction slips issued till last date (including any extension, if any) of submission of bid. Unless specified otherwise, all the PCC work shall be of 1:4:8 Cement content of 174 kg and thickness of PCC shall be 100mm for foundations and 1:5:10 and thickness of PCC shall be 100mm for flooring

2.7. RCC WORKS:

Foundation shall be with RCC pile, isolated/combined, strip, raft type footing & retaining walls as per structural drawing using specified grade of concrete. The foundation level shown in the structural & architectural drawings are for supporting the foundation on firm strata as per SBC specified therein. The minimum depth of foundation shall be 3m with respect to existing ground level at particular location. However, care shall be taken to ensure to support the footings on firm strata as per minimum SBC specified in structural drawings. The mandatory tests required in accordance with IS 10042 need to be carried out during construction by the Contractor. Subsurface conditions encountered during construction may vary somewhat from the conditions encountered during site investigation. There is likelihood of encountering localized clay seams in the type of formation that exists at site. Therefore, it is essential to examine the founding levels very carefully during excavation and remove the same if met with till firm strata is ensured prior to laying of PCC. It should be ensured that at foundation level, no voids are there, if voids are observed the same shall be grouted. Necessary soil stabilization measures shall be implemented by the Contractor to achieve the bearing capacity as specified in structural drawings. Any deviation in earth work, concrete work, RCC work, or any other items of works will be ignored and nothing extra shall be paid on account of varying foundation level (in order to ensure supporting of foundation on firm strata and at minimum SBC specified in structural drawings). The Contractor shall quote the rate accordingly. RCC retaining shall be provided as per drawings and site condition. Unless specified otherwise, all structural members like footings, Columns, Beams, slabs etc. shall be provided with specified grades of concrete as under –

S. No.	Structural Element	Grade of Concrete
1	Foundations (Isolated or combined Footings, Pedestals, Rafts, Strip footings etc.	M-30
2	Pile Foundations	M-30
3	Columns and Shear Wall	M-40
4	Beams	M-30
5	Slabs	M-30
6	STP	M-35

Design Mix Concrete (from Batch Mix Plant or from RMC Plant)

Design mix is to be carried out as per IS 10262, IS 456, IS 4926, and other relevant IS codes / CPWD Specifications amended up to last date (including extended date, if any) of submission of bid. The Contractor shall carry out design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified. The cement shall be actually weighed as presumption of each bag having 50 kg

shall not be allowed. In case of use of admixture, the mix shall be designed with these ingredients as well. All the ingredient shall confirm to relevant Indian standard as well as the CPWD specification.

The Contractor shall install fully automatic Batch Mix Plant at each site wherever permissible. Under special circumstances, Contractor will arrange concrete from RMC (Ready Mix Concrete) producing plants (located within 10 km distance from the site of work) with prior approval from Engineer-in-charge. Nothing extra shall be payable for sourcing concrete from RMC plant. For all purposes, the Contractor shall carry out fully, the responsibilities of the "placement Contractor" and the "manufacturer of concrete".

Mobile Batching Plant of capacity 7 to 9 Cu.m. should mandatorily be Set-up within the Site boundaries for carrying out the M40 grade concreting work on continuous supervision of the PMC members & The Engineerrepresentative.

The The Engineerwill reserve the right to inspect at any stage and reject the concrete if he is not satisfied about quality of product at the user's end.

The The Engineerreserves the right to exercise control over the: -

Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials, recording of test results and declaring the materials fit or unfit for use in production of mix.

i. Calibration check of the Fully Automatic Batching plant /RMC.
ii. Weight and quantity check on the ingredients, water and admixtures added for batch mixing.
iii. Time of mixing of concrete.
iv. 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, if required.

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

For exercising such control, the The Engineershall periodically depute his authorized representative at the fully automatic batching plant/ RMC. It shall be responsibility of the Contractor to ensure that all necessary equipment, manpower & facilities are made available to Engineer-in- Charge and/or his authorized representative at fully automatic batching plant/ RMC.

All required relevant records of produced and used concrete shall be made available to the

Engineer- in-Charge or his authorized representative or PMC. The Engineershall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production & transportation of concrete mix which shall be binding on the Contractor. Only concrete as approved in design mix by The Engineershall be produced and transported to the site.

The terms machine batched, machine mixed and machine vibrated concrete used elsewhere in agreement shall mean the concrete produced in concrete batching and mixing plant and if necessary transported by transit concrete mixers, placed in position by the concrete pumps, tower crane and vibrated by surface vibrator /needle vibrator / plate vibrator, as the case may be to achieve required strength and durability.

No fly ash mixing at site would be allowed. However, with prior approval of Engineer-in-charge, flyash mixing can be allowed at the Batching plants at site with proper handling mechanism and quality of fly ash as per codal requirement,

Under Special circumstances, Contractor can be allowed to procure concrete from RMC plant approved by engineer-in-charge. However, nothing extra shall be payable to the Contractor on this account.

The concrete mix design with and without admixture will be carried out by the Contractor, at his own cost, through one of the following laboratories/Test houses to be approved by Engineer-in- charge: -

i. IIT Guwahati
ii. National Institute of Technology
iii. Govt. Engineering College as approved by Engineer- In Charge
iv. 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-in-Charge.

Ultrasonic Pulse Velocity Method of Test for RCC

a) The underlying principle of assessing the quality of concrete is that comparatively higher velocities are obtained when the quality of concrete in terms of density, homogeneity and uniformly is good. The consistency of the concrete as regards its general quality gets established. In case of poorer quality lower velocities are obtained. If there are cracks, voids or flaws inside the concrete which come in the way of transmission of pulse, lower velocities are obtained.

b) The quality of concrete in terms of uniformity, incidence or absence of internal flaws, cracks and segregation etc. indicative of the level of workmanship employed, can thus be assessed using the guidance given in table below, which

have been evolved for characterizing the quality concrete in structure in term of the ultrasonic pulse velocity.

Velocity criterion for Concrete Quality Grading

S.No.	Pulse Velocity by Cross Probing (Km/Sec)	Concrete Quality grading
1	Above 4.5	Excellent
2	4.5 to 3.5	Good
3	3.5 to 3.0	Medium
4	Below 3.0	Doubtful

c) Pulse velocity method of test of concrete is to be conducted for as a routine test. The acceptance criteria as per the above table will be applicable which is as per IS 13311 (part-1): 1992. From the above "Good" and "Excellent" grading are acceptable and below these grading the concrete will not be acceptable.

d) At least 5% of the total number of RCC members in each category i.e. beam, column, slab and footing may be tested by UPV test method for establishing quality of concrete. It is suggested that test be conducted on RCC beam near joint with column, on RCC column near joint with beam, on RCC footings and rafts. On RCC rafts a suitable grid can be worked out for determining number of tests. In addition, doubtful areas such as honeycombed locations, locations, where continuous seepage is observed, construction joints and visible loose pockets will also be tested.

The test results are to be examined in view of the above acceptance criteria "Good" and "Excellent" and wherever concrete is found with less than required quality as per acceptance criteria, repairs to concrete will be made. Honeycombed areas and loose pockets will be repaired by grouting using Portland Cement Mortar/Polymer Modifies Cement Mortar /Epoxy Mortar, etc. after chipping loose concrete in appropriate manner. In areas where concrete is found below acceptance criteria and defects are not apparently visible on surface, injecting approved grout in appropriate proportion using epoxy grout /acrylic Polymer modified cements slurry made with shrinkage compensating cement / plain cement slurry etc will be resorted to for repairs (refer relevant chapters from CPWD Hand Book on Repairs and Rehabilitation of RCC Buildings). Repair to concrete will be done till satisfactory results are obtained as per the acceptance criteria by retesting of the repaired area. If satisfactory results are not obtained dismantling and relaying of concrete will be done at the cost of Contractor.

Standard of acceptance shall be same as specified in clause 16 of IS 456-2000. In case of rejection of concrete on account of unacceptable compressive strength, the work for which samples have failed shall be redone at the cost of Contractors. However, the The Engineer may order for additional tests (like cutting cores, ultrasonic pulse velocity test, load test on structure or part of structure etc) to be carried out at the cost of Contractor to ascertain if

the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The Contractor shall take remedial measures necessary to retain the structure as approved by the The Engineer without any extra cost.

Cover/ Spacer Block- The Contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for cover in the drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. Only factory-made cover blocks shall be used. Pre-cast cement mortar/concrete blocks/blocks of polymer shall not be used as spacer blocks unless specially approved by the Engineer-in-charge. This shall be done as per approval of The Engineer without any extra cost.

Construction Joints

Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 10 mm × 25 mm deep shall be neatly formed and finished. The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried and filled with hot poured sealing compound conforming to grade B of IS 1834. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer.

2.8. SHUTTERING / FORMWORK:

The work shall be done in general as per CPWD Specifications 2019, Volume-I & II with date revisions/ amendments / correction slips issued upto last date of submission of bid.

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

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

As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept lower than general floors as required from waterproofing point of view. Shuttering should be adjusted accordingly. Nothing extra is payable on this account Dented, broken, cracked, twisted or rusted shuttering shall not be allowed to be used on the work. The shuttering shall be

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

For the execution of centering and shuttering, the Contractor shall use propriety shuttering oil as approved by The Engineerand nothing extra shall be paid on this account.

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

2.9. REINFORCEMENT:

The reinforcement work shall be done as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips upto last date of bid submission (including extensions if any).

Reinforcement work includes all operations including straightening, cutting, bending, welding, binding with annealed steel or welding and placing in position at all the floors with all leads and lift complete as per CPWD Specifications.

The Contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as mentioned in the drawings. Spacer blocks of required shape and size, chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. To ensure proper cover, factory made round / rectangular type cover blocks will be used to avoid displacement of bars in any. Couplers shall be used for splicing of reinforcement bars.

Reinforcement TMT bars, to be used for the work, shall be corrosion resistance TMT bars of grade Fe 500D.

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

2.10. MASONRY WORK:

The masonry work shall be done as per CPWD Specifications 2019, Volume-I & II with revisions / amendments / correction slips upto last date of bid submission (including extensions if any). In case of conflict or contradiction between detailing shown in drawings and specification mentioned herein under this subhead, the specification mentioned herein under this subhead will be followed.

Chicken mesh 24 gauge 19 mm size galvanised chicken wire mesh of approved make and design to be provided at junctions of RCC or CC members and brick work and other locations including necessary clips and "U" nails rawl plugs, screws etc. complete for all height as per specifications & direction of the Engineer-In-Charge.

For masonry work above plinth level, RCC band at sill level and lintel level shall be provided. This thickness of the band shall be 100 mm or as per in drawing as approved by the Engineer-in-Charge.

All opening on masonry wall shall be provided with RCC lintels, RCC bands / lintel over top of parapet wall at corridors, balconies etc. with specified grade of concrete as shown in the drawing or as approved by Engineer-in-Charge.

AAC blocks masonry shall be of Grade I and of oven dry density 551-650 kg/cum with Cement Mortor 1:4 mix (1 cement : 4 coarse sand).

a) Dimensions & Tolerances: Autoclave Aerated Concrete Block shall be made in sizes and shapes to fit different needs.

b) The maximum variation in the length of the Autoclave Aerated Concrete Block shall not be more than plus/minus 5mm and maximum variation in the height and width of Autoclave Aerated Concrete Block, not more than plus/minus 3mm.

c) The faces of Autoclave Aerated Concrete Block shall be flat & Rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angle to the face of the Blocks. The Autoclave Aerated Concrete Block with special faces shall be manufactured and supplied if so required.

d) The autoclaved Autoclave Aerated Concrete Block shall be classified in two grades according to their compressive strength as indicated in table below:

S.N.	Density in Oven dry Condition (Kg/m3)	Compressive Strength (N/mm2)		Thermal Conductivity inair dry condition (W/m.k)
		Grade I	Grade II	
1	451 to 550	2.00	1.50	0.21
2	551 to 650	4.00	3.00	0.24
3	651 to 750	5.00	4.00	0.30
4	751 to 850	6.00	5.00	0.37
5	851 to 1000	7.00	6.00	0.42

e) All Autoclave Aerated Concrete Block shall be sound, free of cracks or other defects which interfere with the proper placing of block units impair the strength or performance of the construction. Where block units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks or other imperfections except that if not more than 5% of a consignment contains slight cracks or small chippings not larger than 25mm, this shall not be deemed grounds for rejection.

f) Block Density – The Block density shall conform to the requirements specified in above table, when tested accordance with IS 6441 (Part-1) -1972.

g) Compressive Strength – The min. compressive strength being the average of twelve block units shall be as prescribed in above table, when tested accordance with accordance with IS 6441 (Part-5) -1972.

h) Thermal Conductivity – The thermal conductivity shall not exceed the values specified in above table when tested accordance with IS 3346 -1980.

i) Drying Shrinkage – The drying shrinkage shall be not more than 0.05% for grade –1 block and 0.10% for grade-2 block when tested accordance with IS 6441 (Part-2) -1972.

j) Number of tests: A sample of 24 blocks shall be selected at random. All the 24 Blocks shall be checked for dimensions and inspected for visual defects. Out of the 24 blocks, 12 blocks shall be subjected to the test for compressive strength, 3 blocks to the test for density, 3 blocks to the test for thermal conductivity and 3 blocks to the test for drying shrinkage. The remaining 3 blocks shall be reserved for re-test for drying shrinkage if a need arises.

k) The samples of AAC blocks (each sample consisting of 6 specimen) shall be chosen randomly from the lot procured and tested for various parameters specified as above. One samples shall be tested for every 200 cum or part thereof. However, minimum one sample shall be tested from each lot received at site if the quantity procured in the lot is less than 200 cum. If required, The Engineeror his authorized representative shall inspect the factory during production of the material for this work and also collect samples (of materials used for making AAC blocks and precast AAC blocks) from the factory itself. The Contractor shall consider this contingency also while placing the order with one of the approved firms. Nothing extra shall be payable on this account.

l) Criteria for conformity: The number of blocks with dimensions outside the tolerance limit and or with visual defects, among those inspected, shall not be more than two. For density, the mean value shall be within the range as specified in above Table. For compressive strength, the mean value, say X shall be determined. The test results shall be grouped into groups of 4, individual values of ranges shall be determined, the average range a calculated from these values and shall satisfy the following condition: X - 0.6 R > minimum value specified in above Table. For thermal conductivity, the mean value shall be equal to or less than the value specified in above Table. For drying shrinkage, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All these blocks shall satisfy the requirements.

m) Manufacturer's Certificate: The manufacturer shall satisfy himself that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

n) Marking: Each lot of concrete masonry units manufactured in accordance with this specification shall preferably be marked with information-

- ❖ The identification of the manufacture
- ❖ The grade and block density of the unit
- ❖ The month and year of manufacturing

Measurements

Autoclave Aerated Concrete Block Masonry shall be measured in cubic metres unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01 metre. ie. 1 cm. Areas shall be calculated to the nearest 0.01 sqm and the cubic contents shall be worked out to the nearest 0.01 cubic metres. Note : (i) Autoclave Aerated Concrete Block work in parapet walls, mumty, lift machine room and water tanks constructed on the roof upto 1.2 m height above roof shall be measured together with the corresponding work of the floor next below

Rate

The rate shall include the cost of materials and labour required for all the operations described. The rate shall also include the following:

(a) Raking out joints or finishing joints flush as the work proceeds;

(b) Preparing tops of existing walls and the like for raising further new block work.

(c) Rough cutting and waste for forming gables, splays at eaves and the like.

(d) Leaving holes for pipes upto 150 mm dia. and encasing hold fasts etc.

(e) Rough cutting and waste for block work curved in plan and for backing to stone or other types off acing.

(f) Embedding in ends of beams, joists, slabs, lintels, sills, trusses etc.

(g) Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls if not covered in respective items

(h) Leaving chases of section not exceeding 50 cm in girth or 350 sq cm in cross-section; and

(i) Block on edge courses, cut brick corners, splays reveals, cavity walls, brick works curved on plan to a mean radius exceeding six metres.

Brick masonry of class designation 7.5, with cement mortar 1:6 (1 cement: 6 coarse sand), shall be done in wet areas. FPS bricks of class designation 7.5 in cement mortar 1:6 (1 Cement : 6 Coarse Sand) shall be used in brick work in foundation upto plinth level and super structure or other masonry work shown in drawings.

Dry Partition Wall:

Glass Reinforced Gypsum (GRG) plaster board shall be confirming to IS 2095 (Pt.-3):1996 (Board with BIS Certification mark) The G.I. frame and board partitions shall be fixed as per nomenclature of the item and directions of Engineer-in-Charge. Joints of the boards shall be finished with specially formulated Jointing compound and fibre tape to provide seamless finish. It is easy and simple to attach different fittings to wall panelling boards. Inclined nails can be fixed to the boards itself for light materials. For heavier materials the fastening should be centered on internal stud work or steel or wood frame behind the boards, fixed before boarding. Services should be incorporated before commencement of board fixing. Tolerance in dimensions shall be + 5 mm.

Measurements

The length and height shall be measured correct to a cm. Area shall be calculated in square meters correction two place of decimal. No deduction shall be made for ducts, opening made from the standard size of panel.

Rate

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

2.11. WOOD & PVC WORK:

The wood work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips up to last date of bid submission (including extensions if any). In case of conflict or contradiction between detailing shown in drawings and specification mentioned herein under this subhead, the specification mentioned herein under this subhead will be followed. The detailing shown in door and window drawings are suggestive only. Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of doors, showing all hardware's) shall be prepared (on the basis of specification laid herein) and submitted by Contractor for obtaining approval from The Engineerand PMC.

The samples of species of timber to be used shall be deposited by the Contractor with the Engineer- in-Charge before commencement of the work. The Contractor shall produce cash vouchers and certificates from standard kiln seasoning plant operator about the timber to be used on the work having been kiln seasoned by them, failing which it would not be accepted as kiln seasoned. Specified timber shall be of good quality and well-seasoned. It shall have uniform colour, reasonably straight grains and shall be free from dead knots, cracks and sapwood.

Wood work shall not be painted, oiled or otherwise treated before it has been approved by the The Engineerand PMC. All portion of timber including architrave abutting against masonry concrete stone or embedded in ground shall be painted with approved wood

preservative or with boiling coal tar.

Door/window schedules is provided with the tender document which shall be followed invariably. If any door type or tag is not mentioned in drawings or door & window schedule, decision shall be given by The Engineerand PMC based on door suggested in door & window schedule for similar functional area. Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of doors, showing all hardware) shall be prepared and submitted for obtaining approval from The Engineerand PMC.

Flush Door Shutters - Flush door shutters shall be of 35 mm thick or of thickness as specified/required/decided (in door & window schedule or in drawings) and conforming to IS: 2202 (Part I) Non decorative type, core of block board construction with frame of 1st class hard wood and well matched teak 3 ply veneering with vertical grains or cross bands and face veneers on both faces of shutters. Stainless Steel butt hinges with necessary screws shall be used for fixing. Lipping with 2nd class teak wood battens of 25 mm minimum depth on all edges of flush door shutters shall be provided. Rebate shall be cut (in frames/shutters) as specified and instructed by The Engineerand PMC. Vision panel of required and specified shape e.g. rectangular, square, circular etc. shall be provided.

Laminates- Flush doors shall be provided with 1.5 mm thick Decorative high pressure laminated sheet (on both side) of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS: 2046 Type S, including adhesive of approved quality. The laminates shall be resistant to fungal attack at the end of 28 days of incubation when tested as per ASTM: G 21 - 2015 test method.

Melamine Polish shall be done (in 3 or more coats to achieve superior finish) on all teak wood & decorative veneered surfaces.

Flush door hardware

Door lock: Providing and fixing Stainless steel (SS 304) Mortice door lock with handles as per CPWD specification and matching to LOM provided lever handles of approved quality with necessary screws etc. complete.

Door closer : Providing and fixing aluminium die cast body tubular type Concealed door closer/PA Bracket (having brand logo with ISI, IS : 3564, embossed on the body, door weight upto 35 kg and door width upto 700 mm), with necessary accessories and screws etc. complete.

Providing and fixing Stainless steel (SS 304) sliding door bolts, ISI marked in matt finish required colour or shade, with nuts and screws etc. complete : 250x16 mm dia 'Providing and fixing stainless steel (Grade 304) tower bolts approved equivalent with necessary screws etc. complete. Size 150 x 10mm & 250 x 10mm

Providing and fixing SS (304)hanging floor door stopper, ISI marked, matt finish with

necessary screws etc. complete. Single rubber stopper

Metal Doors (Pressed Metal Doors): Unless specified otherwise, frame shall be single rebate profile made out of 1.20mm thick (minimum) galvanized steel sheet (18 gauge) and Door shutter shall be single leaf/double leaf fully flush double skin with or without vision panel manufactured from 1.2mm (18 gauge) minimum thick galvanized steel sheet. The profile of frame and thickness of shutter shall be as per manufacturer's specifications. Frames should be mitered, field assembled with self- tab. All provision should be mortised, drilled and tapped for receiving appropriate hardware. The frames shall have inbuilt grooved sealing system and site fitted with PVC seal as standard the frames shall be filled with puff. Frames should be provided with back plate for anchor fasteners for installation on a finished plastered wall opening. The internal construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core filled with mineral wool of density 96 kg/m3. For Double leaf doors astragal has to be provided on meeting stile for both active and inactive leaf. Doors should have passed minimum 500 hours of salt spray test. All doors should be finished with Powder coating (minimum 60 micron) in desired regular RAL Shades.

FRP Doors: - Fiber Glass Reinforced plastic (FRP) Door Frames shall have cross- section 90 mm x 45 mm with single rebate of 32 mm x 15mm to receive shutter of 30 mm thickness. Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The laminate shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame. Fiberglass Reinforced Plastic (F.R.P.) flush door shutter of (30 mm thickness) should consist in different plain and wood finish made with fire retardant grade unsaturated polyester resin, moulded to 3mm thick FRP laminate all around, with suitable wooden blocks inside at required places for fixing of fittings and polyurethane foam (PUF)/ Polystyrene foam to be used as filler material throughout the hollow panel, casted monolithically with testing parameters of laminate conforming to table - 3 of IS: 14856, as per direction of Engineer- In-Charge and PMC.

High Pressure Compact Laminate: It shall be provided as per finishing schedule in 8 mm thick High Pressure interior compact Laminate (of) made out of thermo setting resign treated, Kraft as core material and design paper as a finish surface. The compact laminates should be resistant to water immersion through permissible increase on thickness and mass <0.60% and board should have density >1.35kg/cm^3. compact laminates should be flame retardant and fulfill the criteria of classification of B-s1,d0 of EN 13501-1. It shall have Anti bacterial and anti-termite property as per JIS Z2801:2000, Chemical resistance, Scratch resistant, fire resistance, weather & climatic shock resistance. It should fulfill the criteria of FSC and Green Guard Gold certification and manufactured under EN438-2&3:2005 standard. Finish and colour of compact laminates should be finalized under direction of Engineer–in-charge. compact laminates should be installed on 25x50mm aluminum tube or approved tube size at 500mm c/c under desirable height and fixed through same compact colour rivets or compact adhesive as per recommended by manufacturer's specification/instructions. Finish and colour of

Interior clade should be approved under The Engineerand PMC direction. The manufacturer should provide 10 years warranty certification on any manufacturing and moisture related defects.

Wall Guard, Corner Guard:

Wall guard, corner guard and hand rails shall be provided invariably in all corridors, Lobbies, internal ramps. Corner guards shall be provided at every corner. Wall guard and handrails shall be provided at 750 mm from FFL or at height specified in drawings or conforming to relevant standards.

a) The wall guard should be superior impact resistance wall guard vinyl (Lead free) Snap on cover of 0.080'' (2mm) thickness extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Surface shall have a Pebblette texture for scratch and stain resistance mounting on continuous aluminum retainer of 0.080"(2mm) thickness shall be fabricated from 6063-T5 aluminium, with a mill finish having dimensions of 6"(152mm) height x 1"(25mm) depth. Inner snap- on vinyl impact black bumper should be of 0.080'' (2mm) thickness x 3.930" (100mm) width x 21mm height, which shall be extruded from chemical and stain resistant unplasticized polyvinyl chloride (uPVC). The system shall resist an impact of 45.5 ft-lbs/inch while producing no visual blemishes upon vinyl cover surface and no deformation in the aluminum retainers, as tested in accordance with applicable provision of ASTM F 476-84 for impact test and shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also confirm to class 'A' fire rating and ASTM D-543 for chemical and stain resistance. It shall include injection molded and end caps with black reveal strip.

b) Handrail should be having rigid vinyl Snap-on cover (Lead Free) of 080" (2mm) thickness extruded from chemical and stain resistant Unplasticized Polyvinyl Chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (Plasticizers may aid in bacterial growth). Surface shall have a Pebblette texture for scratch and stain resistance with rigid vinyl cover mounted on a sturdy continuous Aluminum Retainer of .080" (2mm) thickness that shall be fabricated from 6063-T5 Aluminum with a mill finish. Dimensions to be 4-5/16" (110mm) height x 1-5/8" (41mm) Gripping Diameter, extends 3-1/8" (79mm) from wall which has a oval gripping surface. The system shall resist an impact of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256- 90b, impact Resistance of Plastics. The rigid vinyl shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also conform to class 'A' fire rating and ASTM D-543 for chemical and stain resistance. It includes Molded end returns with black reveal strip and mounting brackets.

c) Corner guard should be having Vinyl Snap on cover (Lead Free) of .080" (2mm) thickness extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Surface shall have a Pebblette texture for scratch resistance and stain resistance and shall be mounted on continuous Aluminum Retainer of .070" thickness fabricated from 6063-T5 aluminum, with a mill finish. Dimensions to be of 3" (76mm) x 3" (76mm),90 degree. The rigid vinyl profile shall resist an impact Strength of 30.2 ftlbs/inch as per ASTM D-256-90b and shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also conform to class 'A' fire rating and ASTM D-543 for chemical and stain resistance. It includes Top caps and bottom caps which shall be made of injection molded thermoplastics.

d) Stainless Steel (Grade 304) Braille Labels of size 170mm x 35mm X 0.5 mm having Braille dots raised 0.5mm above base plate with one SS rivet of same grade and adhesive of approved make shall be provided on handrails.

Glazed Doors: All the glazed doors (non-fire rated) be made in toughened glass with necessary fittings and fixtures of stainless steel (SS 304) required to make the door operational and function smoothly, complete as per directions of The Engineer(necessary shop drawings should be prepared by the Contractor and work shall be executed after obtaining approval from Engineer- in-charge in recommendation with PMC). The thickness of glazing should be 12 mm.

Roller Blinds shall be provided of approved make and approved shades having 0.40mm thickness in 100% polyester material with 100% Degree of opacity & having Weight of 375gm/Sqm to 450gm/Sqm in all sizes and for all Heights complete as per the direction of The Engineer.

Cubical track system: Providing and fixing /installation of hospital cubical track system with following specifications: Track material shall in general be aluminum alloy 6063-T-6 having tensile strength 195 MPA, shear strength 150 MPA. All materials shall be corrosion-resistant and shall have minimum 50- micron polyester powder coating of approved shade. Hospital cubical curtains shall consist of anti-microbial polyester blended fabric with 450 mm nylon mesh (net) on the top of curtain. The fabric shall be specially coated with anti- microbial coating and shall be wrinkle free, shrink-proof, anti-odour, anti- fungal and stain-repellent. Curtains shall be fitted with stainless steel grommets at 150 mm centers. Anti-microbial quality of fabric shall be tested by AATC- 147-2004 method (Qualitative method). The shade and design shall be decided by the The Engineer.

All fittings and fixtures shall be as per hardware schedule for doors / windows (mentioned in tender document) and got approved from the The Engineerbefore procurement well in advance and the approved samples shall be kept at site till completion of the work.

Hardware For Doors / Windows:

a) BUTT HINGES: 5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in satin stainless steel as per EN 1935, CE Marked suitable for door weights upto 120kgs

b) VISION PANEL: Unless otherwise specified, toughened glass of 6 mm thickness.

c) GRAVITY COORDINATOR: Door coordinator /sequencer for the double leaf doors of make.

d) DOOR LOCK: 55mm backset, 20mm square for end prepared for euro profile cylinder including strike plate. and EPC 70mm Length both side key operation & Escutcheons in SSS Finish

e) FLUSH BOLT: DORMA lever action flush bolt with 19mm projecting bolt (LENGTH 172 mm OR 300 MM AS PER DIRECTION OF THE ENGINEER) in satin chrome.

f) FLOOR SOCKET: Spring loaded dust excluding floor socket with fixing accessories, in satin Chrome finish.

g) DOOR BOTTOM SEAL : Automatic Door Bottom Seal, Heavy Duty, Face Mounted Version, spring loaded to lift clear of the floor as soon as the door leaf is opened, suitable to be used on Fire and smoke check doors, Seal Material = Silicon, Finish = Anodized Satin Clear, Length = 48" IN SATIN CLEAR FINISH)

h) DELTA SEAL : Delta Seal for acoustic, fire and smoke protection, suitable for wooden and steel frames, self-adhesive, Finish = Black, Length = 1 x 2000mm, Height- 2 x 2750mm IN BLACK FINISH

i) PA BRACKET: Parallel arm bracket suitable for surface mounted door closer for fixing of door closer in Silver finish.

j) ARMOR PLATE: Armour plate with smoothened edges and rounded corners flush face fixing screws height 1000mm and thickness 1.2 mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width.

k) PUSH PLATE: Push plate with smoothened edges and rounded corners flush face fixing screws size 150 x 400 x 1.2 mm in SS 304 grade in satin stainless steel

l) SIGN PLATES: Male/Female/Disable sign plate for WC application with fixing screws size 150x150x1.2 mm, rounded corners in SS 304 satin stainless steel finish with marking in black

m) MOP PLATE: Mop plate with smoothened edges and rounded corners flush face fixing screws height 150mm and thickness 0.9mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width. Max door width =1200mm

n) KICK PLATE: Kick plate with smoothened edges and rounded corners flush face fixing screws height 300mm and thickness 1.2 mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width

o) D type 300mm long CTC, 22mm Dia Pair of pull handle in SS 304 B/B fixing of.

p) Offset type D handle of 450mm long CTC, 25mm Dia pair of handle in SS 304 B/B fixing.

q) FLUSH PULL HANDLE: Stainless steel Flush Pull handle with fixing of screw at flush with surface of doors

r) Door Stoppers: Stainless Steel (grade 304) wall mounted or hanging floor door stoppers in stainless steel satin finish with necessary SS screws etc.

s) Door Closer: Aluminum die cast body tubular type universal hydraulic door closer (having brand logo with ISI mark, IS: 3564, embossed on the body, with necessary accessories and screws etc.

t) Stainless Steel handles: Bright /matt finished Stainless Steel handles (Window) of approved quality & make with necessary screws etc.

u) Pull Handle: 25mm dia, 300 mm long in cranked / square shape stainless steel (Grade 304) satin finish pull handle with necessary screws etc.

v) Sliding Door Bolt: 250x16mm Stainless steel (Grade 304) satin finish sliding door bolts of superior quality with necessary SS screws etc.

w) Mortice Latch: Brushed finished 100mm mortice latch in stainless steel satin/polished finish with euro deadlock (Coin release) with rose rings and pair of stainless steel (grade 304) lever handles with necessary SS screws etc.

x) Tower Bolt: Stainless steel (Grade 304) tower bolts with necessary SS screws etc. complete.

Fire Check / Rated Door:

CPWD Specification 2019 Vol. I & II with revisions/ amendments / correction slips up to last date of bid submission (including extensions, if any), National Building Code (NBC) 2016 and manufacturer's specification will be followed. Fire Check doors shall be provided in buildings wherever necessary and required as per National Building Code 2016, as per door & window schedule and as per architectural drawing provided with tender document. Unless otherwise specified elsewhere in tender document, all fire doors should be fire rated for 120 minute and doors of fire exit corridor should meet the requirement of fire exit corridor specified in NBC 2016. In general all the services/electrical rooms/shafts shall be provided with Metal Fire Check/rated doors whereas all the lobbies, entry/exit to corridors shall be provided with the Glazed fire check/rated doors. Rooms opening in fire exit corridors may be provided with wooden fire check/rated doors. In case of any deviation is found between general principle mentioned herein and Fire check doors shown in architectural drawings (or mentioned door & window schedule), the former general principle (mentioned herein) will be followed. If any door type or tag is not mentioned in drawings or door & window schedule, decision shall be given by The Engineer based on principles mentioned herein. Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of doors, showing all hardware's) shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

The Fire check/rated Door should not collapse during the rated period of the fire under specified fire conditions. The fire door should not allow the passage of hot gases or the flames through the rebate or the gap between the door frame and shutter. The integrity or smoke sealing function is achieved by Fire Door by incorporating an "Intumescent Seal". This Intumescent Seal in the form of a strip, which under fire conditions expands many times its original size and forms a hard char which has high insulation properties and does not permit the smoke or flames to escape through the gap between the shutter and frame.

Observation, if any, made by the fire officer on the fire check/rated doors, shall be incorporated suitably. Nothing extra shall be paid on this account.

Execution of Fire Check Doors shall be carried out through the Specialized Agencies having sufficient work experience in the same field and shall be got approved from the The Engineerwell in advance. Specialized firm shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing the fire check/rated doors. Contractor has to select one specialized agency from list of preferred makes/brands and specialized agencies.

Fire resistance and smoke check doors shall be made of proper sizes and section as per the available opening at the site. The details shown on the drawings indicate generally the sizes of components parts and general standards. These may be varied slightly to suit the standard adopted by the manufactures. Before proceeding with manufacturing, the Contractor shall prepare and submit complete manufacture and installation drawing for approval of the The Engineerand no work shall be performed until the approval of these drawings is obtained.

The term "Fire Rating" referred in tender documents means fire rating of complete assembly of fire check door e.g. frames, shutter, Vision Panel, Glass, Hinges and other hardware's. Doors will be approved only after door passes the required tests from fire testing lab approved by the Engineer-in- Charge. Cost of sample door and testing shall be borne by Contractor.

Doors shall be fabricated to size in factory. Fabricated material shall be protected against any damage during transportation. Loading and unloading shall be carried out with utmost care. On receipt of material at site it shall be carefully examined to detect any damaged units/members. Arrangements shall be made for expeditious replacement of damage units or members. Materials found acceptable on inspection shall be repacked in crates and stored safely.

Just prior to installation, the doors shall be uncarted and stacked on edge on level bars and supported evenly. The frame shall be fixed into position true to line and level using adequate number of fastener of approved size and manufacture and in an approved manner. The holes in concrete /masonry member for housing anchor bolts shall be drilled with an electric drilling machine only.

Stainless steel ball bearing hinges, panic bars, door trims, fire rated hydraulic door closers, handles, tower bolts, lock and other fittings shall be as per hardware schedule for doors &

windows provided in tender document and shall be got approved from Engineer-in-Charge. All Hardware's should have a minimum 02 Years of manufacturer warrantee from the date of supply. Hardware's should pass European certificate "CE" of conformity / UL certified with required fire ratings and relevant documents to this effect shall be produced at the time of approval of samples.

The design of fire check/rated doors and material to be used in their construction have to be such that the doors shall be capable of providing an effective barrier of desired rating.

Glazed Fire Check / Rated Doors / Window / Partition –

a. Fire check/rated glazed door/window/fixed partition, shall be provided as per following specification.

b. Non load bearing fixed frame for fire resistant glazed Partition for 120 min Fire Rating, should be made out to a profile of dimension 60mm x 70 mm of 1.6 mm thick galvanized steel sheet as per test evidence suitable for fixing fire rated glass for 120 min of both integrity & radiation control (EW120) & minimum 20 min of insulation (EI20).The profile has to be fixed to the supporting construction by means of anchor fasteners of size M10 x 80, every 150 mm from the edges and every 500 mm (approx) c/c. The frame shall be filled with mineral wool insulation of density min 96kg/m^3 and finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge.

c. Fire resistant door frame of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/ m^2) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96 Kg/m^3. The frame will have a provision of G.I. Anchor fasteners 14 nos (5 each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with an approved fire resistant primer or Powder coating of not less than 30 micron in desired shade as per the directions of Engineer - in- charge.

d. Glazed fire resistant door shutters should be 60 mm thick with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m^2) duly filled mineral wool insulation having density min 96 kg/ m^3 and fixing with necessary stainless steel ball bearing hinges of size 100x89x3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc. all complete as per direction of Engineer-in- charge. Glazed fire resistant door shutters should be

having 120 min Fire Rating confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by Engineer-in-charge.

e. Providing and fixing glazing in fire resistant door shutters, fixed panels & partitions etc., with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m²) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c , including applying a coat of approved fire resistant primer/ powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc. complete in all respect as per NBC 2016, IS 16231 (Part 3):2016 and as per direction of The Engineerwith bidirectional inter layered glass of required thickness having 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 20 minutes of insulation (EI20). The manufacturer have to give test report/certification of fire glass and the glass should have the stamp showing the value of E, EW & EI. The glass shall be tested in approved NABL accredited lab or by any other accreditation body which operates in accordance with ISO/IEC 17011 and accredits labs as per ISO/IEC 17025 for testing and calibration scopes shall be eligible.

Metal Fire Check / Rated Doors-

a. Metal Fire door shall be from ISO 9001:2015 certified manufacturers. The door must have been manufactured with galvanized - GI sheet of GPSP Grade as per IS 277. All Fire doors must satisfy the requirement of latest NBC 2016 Part 4 for Fire & Life Safety guidelines. The Prototype sample of the door must carry a prior test evidence as per IS 3614 part-2 / BS 476 Part 20 & 22. The manufacturer must submit the copy of test evidence prior to start of production. The offered test certificate should either carries it's Validity or certificate must not be older than 5 years from CBRI / NABL Accredited Lab. All doors should be finished with Powder coating (minimum 60 micron) in desired regular RAL Shades.

b. Door frame shall be Single rebate profile of section 125 x 55 mm made out of minimum 1.20mm thick galvanized steel sheet with a factory pre-punched groove so as to accommodate fire seal size (minimum 10x4mm). Frames should be mitered, butt jointed and field assembled with bolting system for proper strength. Frames shall have in built grooved sealing system and shall be site fitted with fire rated EPDM gasket as standard. All provision should be mortised, drilled and tapped for receiving appropriate hardware. Frames should be provided with back plate for anchor fasteners for installation on a finished plastered wall opening.

c. Door leaf should be minimum 46mm thick fully flush double skin door. Door leaf must be manufactured from minimum 1.2 mm (18 gauge) thick galvanized steel sheet. The internal Construction of the door should be rigid reinforcement pads for receiving appropriate hardware. The infill material shall be resin bonded honeycomb core. For Double leaf doors astragal has to be provided on meeting

stile for both active and inactive leaf. Vision panels wherever required should be provided with specified shape and sizes of glass (bidirectional inter layered glass of required thickness).

Fire rated hardware for fire check doors:

All hardware's for fire check/rated doors shall also be fire rated and shall have certification from UL/CE.

a. DOOR CLOSER: Extruded aluminum body Heavy duty Fire Rated Door Closers with full body cover. The Door Closers should be spring adjustable type 2-6, Non handed with back check, and tested along with the fire doors from CBRI Roorkee as per BS476 Part-22 and IS 3614 Part-2. The door closer shall have 10 years mechanical warranty from the manufacturer and complies with EN 1154- for 50000 cycles + A1: 2002 CE Certified

b. BUTT HINGES: 5 Knuckle, 2 bearing butt hinges size 4" x 3" x 3mm, in SS 304 and in satin stainless steel as per EN 1935, CE Marked suitable for door weights upto 120kgs

c. VISION PANEL: Unless otherwise specified, bidirectional inter layered glass of 15 mm thickness shall be used.

d. GRAVITY COORDINATOR: Door coordinator /sequencer for the double leaf doors

e. PANIC BAR-SINGLE POINT: Panic bar / latch (Single point) suitable for single / active leaf of door.

f. PANIC BAR-TWO POINT OR DOUBLE POINT: Panic bar / latch (Two point or Double point) with vertical rod and top and bottom latch suitable for double doors or inactive leaf of door.

g. EXTERNAL TRIM: External trim on back side of the Panic Latch

g. ELECTROMAGNETIC HOLD OPEN-Electro Magnetic hold open device for holding the door in open condition EM with armature plate with 24v DC

h. EM LOCK FOR HOLD OPEN DOOR- Holding force of 1200 lbs EM Lock with 1200 ALH and EM 1200 2ALH with armature receiving plate, surface mounted 12/24 VDC including armature plate holder.

i. DOOR LOCK: 55mm backset, 20mm square forend prepared for euro profile cylinder including strike plate. and EPC 70mm Length both side key operation & Escutcheons in SSS Finish

j. FLUSH BOLT: DORMA lever action flush bolt with 19mm projecting bolt (LENGTH 172 mm OR 300 MM AS PER DIRECTION OF THE ENGINEER) in satin chrome.

k. FLOOR SOCKET: Spring loaded dust excluding floor socket with fixing accessories, in satinChrome finish.

l. DOOR BOTTOM SEAL : Automatic Door Bottom Seal, Heavy Duty, Face Mounted Version, spring loaded to lift clear of the floor as soon as the door leaf is opened, suitable to be used on Fire and smoke check doors, Seal Material = Silicon, Finish = Anodized Satin Clear, Length = 48"IN SATIN CLEAR FINISH

m. DELTA SEAL : Delta Seal for acoustic, fire and smoke protection, suitable for wooden and steel frames, self-adhesive, Finish = Black, Length = 1 x 2000mm, Height- 2 x 2750mm IN BLACK FINISH .

n. PA BRACKET: Parallel arm bracket suitable for surface mounted door closer for fixing of door closer in Silver finish.

o. ARMOR PLATE: Armour plate with smoothened edges and rounded corners flush face fixing screws height 1000mm and thickness 1.2 mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width.

p. PUSH PLATE: Push plate with smoothened edges and rounded corners flush face fixing screws size 150 x 400 x 1.2 mm in SS 304 grade in satin stainless steel

q. SIGN PLATES: Male/Female/Disable sign plate for WC application with fixing screws size 150x150x1.2 mm, rounded corners in SS 304 satin stainless steel finish with marking in black.

r. MOP PLATE: Mop plate with smoothened edges and rounded corners flush face fixing screws height 150mm and thickness 0.9mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width. Max door width =1200mm.

s. KICK PLATE: Kick plate with smoothened edges and rounded corners flush face fixing screws height 300mm and thickness 1.2 mm in SS 304 grade in satin stainless steel. Length=5mm short of the shutter width.

t. Pull handle:

    i. D type 300mm long CTC, 22mm dia pair of pull handle in SS 304 B/B fixing.

    ii. Offset type D handle of 450mm long CTC, 25mm dia pair of handle in SS 304 B/B fixing.

    iii. FLUSH PULL HANDLE: Stainless steel Flush Pull handle with fixing of screw at flush with surface of doors.

    iv. Pull Handle: 25mm dia , 300 mm long in cranked / square shape stainless steel (Grade 304) satin finish pull handle with necessary screws etc.

u. Door Stoppers: Stainless Steel (grade 304) wall mounted or hanging floor door stoppers in stainless steel satin finish with necessary SS screws etc.

v. Sliding Door Bolt: 250x16mm Stainless steel (Grade 304) satin finish sliding door bolts of superior quality with necessary SS screws etc.

w. Mortice Latch: Brushed finished 100mm mortice latch in stainless steel satin/polished finish with euro deadlock (Coin release) with rose rings and pair of stainless steel (grade 304) lever handles with necessary SS screws etc.

x. Tower Bolt: Stainless steel (Grade 304) tower bolts with necessary SS screws etc. complete.

uPVC:

Factory made uPVC white colour sliding glazed window upto 1.50 m in height dimension comprising of uPVC multi-chambered frame with in-built roller track and sash extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), appropriate dimension of uPVC extruded glazing beads and uPVC extruded interlocks, EPDM gasket, wool pile, zinc alloy (white powder coated) touch locks with hook, zinc alloy body with single nylon rollers (weight bearing capacity to be 40 kg), G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete as per approved drawing & direction of Engineer-in-Charge. (Single / double glass panes, wire mesh and silicon sealent shall be paid separately). Variation in profile dimension in higher side shall be accepted but no extra payment on this account shall be made.

For uPVC frame and sash extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceptable.

Two track two panels sliding window made of (big series) frame 67 x 50 mm & sash 46 x 62 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension . (Area of window above 1.75 sqm upto 2.50 sqm).

Window Accessories: 'Bright/matt finished Stainless Steel handles of approved quality & make with necessary screws etc all complete as per engineer incharge.

Guarantee for uPVC Work:

The Contractor shall guarantee about proper design and performance of uPVC work for a period of 10 years from the date of completion of work.

The design and installation shall be to the best international standards and shall specially take account of wind and seismic loads, storms, thermal stresses, building movements and the like.

The 10 year guarantee, shall be furnished in non-judicial stamp paper of value Rs.100/- or more, in prescribed proforma for performance of glazed units, anodizing, EPDM/silicon gaskets and sealants. The guarantees shall be submitted before final payment and shall not in

any way limit any other rights to correct which the The Engineermay have under the Contract.

2.12. ALUMINUM WORK:

(a) Before taking up any procurement/construction activity, shop drawings (for fixing of all kind of Aluminum Works, showing all hardwares) shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

(b) Minimum weight of aluminum section for door, windows and ventilators shall be as per relevant standards.

(c) Kiln seasoned hard wood shall be filled inside door frames on hinged side and top of frames wherever hydraulic door closers are to be provided.

(d) Frames shall be fixed with dash fastener of minimum size 10 x 100 mm as per approved shop drawings.

(e) Gap between aluminum frame / aluminum window and adjacent RCC / masonry work shall be filled by providing weather silicon sealant over backer rod of approved quality as per direction of Engineer-in-Charge.

(f) The material for the work shall be procured from the approved manufacturer as per preferred make list for materials in this contract agreement. The Contractor shall procure and submit samples of various materials to be used in the work for the approval of The Engineerand no work shall commence before such samples are approved. Samples of un-anodized as well as polyester powder coated aluminum sections, microwave cured EPDM gaskets, glass, stainless steel screws, anchor fasteners, hardware and any other material or components requiring approval of samples, in opinion of Engineer-in-Charge, shall be submitted for the approval as mentioned above. The above samples shall be retained as standards of materials and workmanship.

(g) Aluminum sections to be used for various works shall be appropriate to meet technical, structural, functional and aesthetic considerations. Aluminum work for doors, windows, ventilators and partitions etc. shall be with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminum sections shall be smooth, rust free, straight, mitered and jointed mechanically wherever required including cleat angle, Aluminum snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. Polyester powder coated aluminum (minimum thickness of polyester powder coating 50 micron) section shall be used. Hinges/ pivots, provision for fixing of fittings, EPDM rubber / neoprene gasket shall be provided wherever required. The polyester powder coating shall be carried out in a factory / workshop approved by engineer-in-charge.

(h) Glass in Windows/Ventilators: Glazing in windows, ventilators and partition etc. shall be Double glazed hermetically sealed with 6 mm thick toughened glass both side, having 12 mm air gap, including providing EPDM gasket, perforated aluminum spacers, desiccants, sealant (Both primary and secondary sealant) etc. as per specifications, drawings and direction of The Engineercomplete. The DGU unit shall have visible Light transmittance (VLT) of minimum 65%, Light reflection internal - less than or equal to 23%, Light reflection external - less than or equal to 23 %, SHGC- less than or equal to 0.6 and U value - less than or equal to 2.5 W/m2 degree K.

(i) Frameless glass partition and doors: Frameless glass partition and doors shall be made out of 12 mm thick (minimum) toughened glass of approved brand and manufacture, including providing and fixing top & bottom pivot & double action hydraulic floor spring, fixing arrangement and making necessary holes etc. for fixing required fittings, all complete as per direction of Engineer-in- charge.

(j) Hydraulic floor spring: It shall be double action hydraulic floor spring conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight up to 125 kg, for doors, cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc.

(k) Mortice Latch & lock: It shall be of Brass 100 mm mortice latch and lock with 6 levers without pair of handles (best make of approved quality) for aluminum doors in partition.

(l) Fabrication: The factory for fabrication and coating of aluminum partition frameworks shall be got approved from Engineer-charge. The fabrication unit should have experience of having done similar work of similar cost in 7 years prior to date of submission of proposal by Contractor.

(m) All joints shall be accurately fabricated and be hairline in appearance. The finished surface shall be free from visible defects. All the aluminum partition shall be factory made and shall be brought to site for assembly and fixing.

(n) All hardware used shall conform to the relevant specifications mentioned in door window hardware schedule and as per samples approved by the Engineer- in-Charge. Design, quality, type, number and fixing of hardware shall be generally in accordance with shop drawings and as approved by the Engineer- in-Charge before use.

(o) All doors, windows, ventilators and glazing etc. shall be made water tight with microwave cured EPDM gaskets and weather silicone sealants to the satisfaction of the Engineer-in- Charge.

(p) The frames shall be strictly as per architectural drawings, the corners of the frame being fabricated to the true right angles. Both the fixed frames and openable shutter frames shall be fabricated out of sections cut to required length, mitered and mechanically jointed for satisfactory performance. All members shall be

accurately machine milled and fitted to form hairline joints. The jointing accessories such as aluminum cleats, stainless steel screws etc. shall not to cause any bi-metallic reaction by providing separators, wherever required. Vertical members of the aluminum frame work shall be embedded in the floors, wherever required, by cutting and making good of the floor.

Fixing Of Aluminum Frame Work

a. The screws used for fixing fixed aluminum frames of the partition to masonry walls / RCC members and aluminum members to other aluminum members shall be of stainless steel of approved make and quality and of stainless steel grade 304. Threads of machine screws used shall conform to requirement of I.S. 4218.

b. For the aluminum partition, the gap between the aluminum frames and the R.C.C / Masonry and also any gaps in the various sections shall be filled with weather silicone sealant DC 795 of Dow Corning or equivalent in the required bite size, to ensure water tightness including providing and fixing backer rod, wherever required. The weather silicone sealant shall be of such approved colour and composition that it would not stain or streak the masonry / R.C.C. work. It should not sag or flow and shall not set hard or dry out under any conditions of weather and shall be tooled properly. The weather silicone sealant shall be used as per the manufacturer's specifications and shall be of approved colour and shade. Any excess sealant shall be removed / cleared.

c. Fixing of glass panes shall be designed in such a way that replacing damaged /broken glass panes is easily possible without having to remove or damage any members or interior finishing materials.

Protections and Cleaning

a. All glass panes shall be retained within aluminum framing by use of exterior grade microwave cured EPDM gaskets. Use of glazing or caulking compounds around the perimeter of glass will not be permitted. There shall be no whistling or rattling. Before installation of glass, Contractor shall ensure the following:

b. All glazing rebates shall be square, to plumb, true to plane, dry and free from dust.

c. Glass edge shall be clean and cut to exact size and grounded

d. Glass of specified thickness in doors, windows, ventilators and fixed glazing etc. shall be of approved make and standard quality conforming to C.P.W.D. Specifications

Guarantee for Aluminium Work

The Contractor shall guarantee about proper design and performance of aluminum work for a period of 10 years from the date of completion of work.

The design and installation shall be to the best international standards and shall specially take account of wind and seismic loads, storms, thermal stresses, building movements and the like.

The 10 year guarantee, shall be furnished in non-judicial stamp paper of value Rs.100/- or more, in prescribed proforma for performance of glazed units, anodizing, EPDM/silicon gaskets and sealants. The guarantees shall be submitted before final payment and shall not in any way limit any other rights to correct which the The Engineermay have under the Contract.

Measurements

All the aluminium sections including snap beadings fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment (weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

Rate

The rate shall include the cost of all the materials, labour involved in all the operations as described in nomenclature of item and particular specification.

2.13. FLOORING, MARBLE, CLADDING WORK:

All flooring work and cladding work in Granite, Tile, Marble, Stones, Wooden, Carpet etc. in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips upto last date of bid submission (including extensions if any). The tiles / stones shall be as specified in the schedule of finishes and architectural drawings provided with tender document. The tiles / stones shall be of approved colours and shades and will be laid in pattern as per approved architectural drawings or shop drawings. Nothing extra shall be paid for laying tiles / different stones in specific design/pattern. The tiles shall be of first quality of approved make and nothing extra shall be paid for use of cut/saw tiles in the work. Schedule of finishes mentioned in tender documents shall be followed in case of deviation/different detailing is shown in Architectural Drawings. Before taking up any procurement/construction activity, shop drawings shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

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

Samples of flooring material are to be deposited well in advance to the Engineer- in-Charge for approval. Approved samples should be kept at site with the The Engineerand the same shall not be removed except with the written permission of Engineer-in-Charge.

The samples shall be submitted along with the following details:

a. Three representative samples for each type of flooring/cladding specified.

b. Details of physical characteristics such as dimensional tolerances (within the specified limits), water absorption, compressive strength, Mohs Hardness, Specific gravity with reference to IS or International standards.

c. Source of supply and confirmation of availability in full quantity and uniformity of colour, tone and textures.

d. Company profile of Suppliers.

The The Engineeror his representative may, if required, visit the source of supply of the various materials (Granite/Stones/Marble/Tiles/Cladding etc.) to assess the quality as well as availability of the material in the required quantities.

The entire supply for each type of granite/stone slabs shall be procured from one location (in one quarry), and supplied preferably, in one lot to keep variations to the minimum. The Contractor shall also segregate and sort the slabs according to colour, shade, texture and size of grains etc. to keep variation(s) in stones used at any one floor to the minimum. Any slab with variation in the colour, shade, texture and size of grains etc., not acceptable to the Engineer-in- Charge/PMC, shall not be used in the work and shall be removed and replaced by the Contractor. Nothing extra shall be payable on these accounts. Also, no claim of any kind shall be entertained from the Contractor on this account.

Based on the samples approved by the The Engineerfor various flooring and dado / cladding materials as specified hereinafter, the Contractor shall prepare mock up(s) at site of work for approval of quality of workmanship and material specified. If the quality of the workmanship and the material is as per the required standards and approved by the Engineer-in- Charge, the mock up shall be allowed as part of the work. Otherwise, it shall be dismantled by the Contractor as directed by the The Engineerand taken away from the site of the work at his own cost. The mock up(s) so made shall be kept till completion of respective works for reference.

The (Granite/Stones/Marble/Tiles/Cladding etc.) shall be transported to site well packed in boxes or otherwise. These shall be handled carefully to prevent any damage. Granite stone slabs shall be individually packed in cardboard paper. The various types of stones and tiles, procured shall be free of any surface defect or any edge damage. The damaged (Stones/Marble/Tiles/Cladding etc.) shall not be allowed to be used in the work. So, the Contractor shall procure additional quantity of the stone and tiles to cover such contingencies. The stone slabs shall not be waxed or touched up with dyes / colours

The following tolerances shall be allowed in the dimension of granite stone slab:

a) Length ± 1mm
b) Width ± 1mm

c) Thickness - 1mm
d) Angularity at corners ± 0.25%

The stone (slab and tiles) not meeting the above tolerance limits shall be rejected and not permitted to be used in the work. Nothing extra shall be payable on this account.

Stones slabs shall have uniform thicknesses within the tolerance limits and linear items like treads, sills and jambs, coping, risers, urinal partitions, kitchen / wash basin platforms, vanity counters, facias and other similar locations etc. shall have edge polished calibrated thickness i.e. exposed edges shall have edge polished uniform thickness throughout the length of the work.

The flooring work shall be carried out as per the architectural drawings in design and pattern (geometric, abstract etc.) and in linear and / or curve linear portions and in combination with stones of different colour and shade and ceramic tiles etc. For the flooring portions curved in plan, the stone slabs (at the edge) shall be cut to the required profile and shape as per the architectural drawings. Nothing extra shall be payable on this account and any consequent wastage and incidental charges on such accounts shall be deemed to be included in the cost.

The granite slabs used for providing and fixing in the sills, soffits and jambs of doors, windows, ventilators and similar locations shall be in single piece unless otherwise directed by the Engineer- in-Charge. Wherever stone slab other than in single piece is allowed to be fixed, the joints shall be provided as per the architectural drawings and as per the directions of the Engineer-in-Charge. In the cabin areas, the joints in sills shall preferably be provided in line with the partition wall. Depending on the number of joints, as far as possible, the stone slabs shall be procured and fixed in slabs of equal lengths as per the architectural drawings and as directed by Engineer-in-Charge.

The specifications for dressing, laying, curing, finishing etc. for the granite stone flooring shall be same as that of works for the Marble flooring, skirting and risers of steps under Flooring Sub Head of the CPWD Specifications. The wall lining / veneer work with granite stone shall be as per the CPWD Specifications for Marble work Sub Head.

All the tiles (flooring/wall lining/Skirting/dado) shall be fixed with quick set tile adhesive (of make Pidilite, Ardex endure, Weber) of minimum thickness of 6 mm. Also joints of flooring tiles having 3 mm width shall be grouted using epoxy grout (of Pidilite, Ardex Endure, Weber) mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg).

Wet stone/granite wall cladding (in interior) shall be fixed in average 20 mm thick cement mortar in 1:3 (1 cement: 3 coarse sand), and proper adhesives with copper pins 7.5 cm long, 6 mm diameter for securing adjacent stones in stone wall lining. Dry stone cladding shall be fixed with proper adhesives as approved by the engineer incharge for the exterior cladding works

Unless specified otherwise, all stone/granite/marble in flooring shall be laid on 20 mm (average) thick base of cement mortar 1:4 (1 cement: 4 coarse sand) and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade.

Unless otherwise specified, all stone/granite/marble in skirting/wall lining/dado shall be fixed on 20 mm (average) thick base of cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade.

For flooring work, the joints between the different types of flooring shall be located as per the architectural drawings. Also, the Contractor shall maintain the uniform level of the finished flooring of the different types unless specifically mentioned on the architectural drawings.

All the flooring works specified under this sub-head shall be adequately protected by a layer of Plaster of Paris which shall be laid over a 400- m i c r o n PVC film. The protective layer shall be maintained throughout the execution of works and removed just before handing over of the site.

One piece Granite stone for treads / risers in staircase shall be used including rounding of nose.

POP protection layer shall be laid on all finished floors for protection from damage during execution of other items of work in that area which shall be removed and cleaned just before handing over of the premises.

For the skirting in the enclosures with curvilinear profiles, the (Stones / Marble / Tiles / Cladding etc.) shall be cut to the required size and the shape to match the profile and/ or the joints as per the architectural drawings. Similarly, the skirting shall be fixed in a manner as to flush or project from the finished face of the wall as per the architectural drawings and as directed by the Engineer – in– Charge. Any chasing of the masonry works required for such fixing is deemed to be included in thecost of masonry.

Granite stone tiles and slabs shall be pre polished (mirror polished), eggshell polished, flame finished or given any other surface treatment as specified in finishing schedule or architectural drawings and as directed by the Engineer-in- Charge.

Machine polishing and cutting to required size shall be done with water (as lubricant) only. Sawing shall also be done preferably with water as lubricant but as a special case, the The Engineer may permit, at his discretion, oil or kerosene as lubricant subject to all kerosene or oil in the body and surface of tiles / slabs being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise, either before or after installation, shall be rejected and shall be replaced by the Contractor at his own cost.

The exposed cut edges of the Kota Stone slab in risers and treads along its width (sides of the risers and treads of the steps i.e. along the shorter dimensions of the Kota stone slab for the

risers and treads) shall be polished in a workmanlike manner. The top exposed edge of the Kota stone skirting shall also be polished in a workmanlike manner.

Nosing / edge moulding shall be provided to the front edge of the Kota stone slab treads along its length i.e. along the longer dimensions of the Kota stone slab, as per the architectural drawings.

Tactile tile such as directional, warning or hazardous (for vision impaired persons as per standards) shall be of size 300x300x15 mm {10 mm base + (5mm ± 0.5mm) thick raised portion} having water absorption less than 0.5% and conforming to IS: 15622 of approved make in all colours (preferably yellow) and shades for indoor floors, should be laid on 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. as per harmonized guidelines and space standards for barrier free built environments for persons with disability and elderly persons issued by Ministry of Urban Development, Govt. of India.

50 mm wide Yellow colour, self-adhesive 'EDGE STRIPS' of approved make shall be provided on risers of staircase to help persons with visual disabilities and elderly. 25 mm wide high intensity Anti-Skid reflective tape of approved make on edges of treads of staircase shall be provided.

Wooden Flooring: Providing and laying 'Engineered wooden or Hard maple wood flooring 20mm thick,length varying from 230mm to 1800mm jointed together with the help of tongue and groove on all four sides of all boards. substructure of maple wood flooring shall consist of sleeper of spruce or pine having 63mm wide and cross section of 38 mm and laid perpendicular to the main flooring planks at a spacing 305mm centre to centre including 19 mm thick rubber shock pads at 305mm centre to centre spacing and polyethylene membrane installed over the concrete base beneath the flooring system as a vapour barrier between the concrete and wood floor. 0.20mm polyethylene membrane installed over the concrete base beneath the flooring system as a vapor barrier between the concrete and wood floor. approved by bwf complete satisfaction of the Engineer in-charge.

At the time of handing over, flooring & dado / cladding shall be free of any scratches, stains etc. The flooring & dado / cladding shall be properly cleaned before handing over. However, abrasive cleaners shall not be used to clean the marks and other scratches.

2.14. ROOFING WORK:

All roofing work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with revisions/ amendments / correction slips up to last date of bid submission (including extensions if any). Schedule of finishes mentioned in tender documents shall be followed in case of deviation/different detailing is shown in Drawings. Before taking up any procurement/construction activity, shop drawings shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

Calcium Silicate False Ceiling Tiles :

Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on interlocking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanized butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge.

8 mm thick fully perforated calcium silicate board made with Calcareous & Siliceous materials reinforced with cellulose fiber manufactured through autoclaving process to give stable crystalline structure with minimum compressive strength 225 kg/ sq. cm, bending strength 100 kg/sq. cm, of size 595x595 mm, having perforation of dia. 10 mm with minimum perforated area 18 % with non woven tissue on the back side, having an NRC (Noise Reduction Coefficient) of 0.85, with 50 mm thick rock wool of 48 kg /cum backing.

Metal False Ceiling Tile :

Providing and fixing Gl Clip in Metal Ceiling System of 600x600 mm module which includes providing and fixing 'C' wall angle of size 20x30x20 mm made of 0.5 mm thick pre painted steel along the perimeter of the room with help of nylon sleeves and wooden screws at 300 mm center to centre, suspending the main C carrier of size 10x38x10 mm made of G.I steel 0.7 mm thick from the soffit with help of soffit cleat 37x27x25x1.6 mm, rawl plugs of size 38x12 mm and C carrier suspension clip and main carrier bracket at 1000 mm c/c. Inverted triangle shaped Spring Tee having height of 24 mm and width of 34 mm made of Gl steel 0.45 mm thick is then fixed to the main C carrier and in direction perpendicular to it at 600 mm centers with help of suspension brackets. Wherever the main C carrier and spring T have to join, C carrier and spring T connectors have to be used. All sections to be galvanized @ 120 gms/sqm (both side inclusive), fixing with clip in tiles into spring T with. GI Metal Ceiling Clip in plain Beveled edge global white color tiles of size 600x600 and 0.5 mm thick with 25 mm height, made of G I sheet having galvanizing of 100 gms/ sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after

bending and perforation.

Mineral Fibre False Ceiling Tiles:

It shall be 19 mm thick of size 595X595mm of approved texture, design and pattern. The tiles shall be confirming to ISO 4 according to norm ISO 14644- 1:2015, having Humidity Resistance (RH) of ⩾ 99%, NRC⩾0.7, Light Reflectance 85-90%, thermal Conductivity k = 0.052- 0.057 w/m K, Fire Performance A2- s1.d0 with Anti- Bacterial coating, adhering to Clean room requirement of Class 100 as per US Fed Standard 209 E and washability requirement of 500 wash cycles as per ASTM 4828 and with Recycled content of minimum 70%. Tiles shall be suspended in true horizontal level on interlocking T-Grid of hot dipped all round galvanized iron section of 0.38 mm thick (galvanized @120 gms) comprising of main T runners of 15x38 mm of length 3000 mm, cross T of size 15x38mm of length 1200 mm and secondary intermediate cross T of size 15x38 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanized @80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 80x30x0.6 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size 24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic Rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. crews. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights.

Calcium Silicate Board:

Providing and fixing false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes , finishing with jointing compound in 3 layers covering upto 150 mm on both

sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the The Engineer.12.5 mm thick tapered edge gypsum moisture resistant board.

Polycarbonate Sheet Roofing

Providing, Supplying & Installation of Microcell Polycarbonate 20mm thick (minimum.) UV protected panel system which shall be uniform in color with an integral Microcell core. They should be manufactured with Vertical Standing Seam with standing seam height of 10-20mm at both sides of the panel. Panels shall be fixed on MS /Trusses. purlins with continuous Structural Aluminum double wall I-profile Spacer together with snap-on connector. These connectors to interlock the panels shall have a 2-4 tooth grip-lock locking mechanism to ensure maximum uplift capability and shall pass a pullout load of min. 4000 N (4kN) when tested as per ISO 6892:1998 and IS 1608:2005. Panel shall be with additional End- cap/Aluminum U-Profile (mill finish) for ends. including glass wool 100 mm Above Panel System shall be fixed over structural steel trusses / MS purlin with 2 coats of Enamel paint etc. conforming to the detail technical specifications as per approved Architectural Drawings submitted by Vendor Items includes cost of 20mm thick Polycarbonate sheet roofing with all its elements(Louvers), accessories , fittings and fixtures, scaffolding, labour , all required machineries for fixing and all valid taxes i.e. sales tax, excise duty, custom duty etc. complete. The above work is to be carried out by a Specialized Agency, as approved by the The Engineerinclude for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc complete for the finished as direction by The Engineer.

Galvalume Sheet Roofing :

Precoated Galvanised iron profile sheets (size, shape and pitch of corrugation as approved by Engineer-in-charge) 0.50 mm (+ 0.05 %) total coated thickness with zinc coating 120 grams per sqm as per IS: 277, in 240 mpa steel grade, 5-7 microns epoxy primer on both side of the sheet and polyester top coat 15-18 microns. Sheet should have protective guard film of 25 microns minimum to avoid scratches during transportation and should be supplied in single length upto 12 metre or as desired by Engineer-in-charge. The sheet shall be fixed using self drilling /self tapping screws of size (5.5x 55 mm) with EPDM seal, complete upto any pitch in horizontal/ vertical or curved surfaces, excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. Providing and fixing precoated galvanised steel sheet roofing accessories 0.50 mm (+0.05 %) total coated thickness, Zinc coating 120 grams per sqm as per IS: 277, in 240 mpa steel grade, 5-7 microns epoxy primer on both side of the sheet and polyester top coat 15- 18 microns using self drilling/ self tapping screws. Rate shall include roofing and wall cladding with necessary lappings, end crimp sheet, edge flashing, painted with regular modified polymer system/silicon modified polyster system and all lappings pasted with Buttyl tape including cost of screws and necessary

scaffolding etc complete as per standard specifications. Rate including all material, all labour charges, all lead, lift, transportation, taxes etc complete and measured per unit of laid areas The quality of material, method of testing, installation etc as per IS codes, unless otherwise specified herein, shall be applicable. In all cases, the latest editions including all applicable official amendments and revisions shall be referred.

Installation: The installation shall be done by specialized agency or approved by the engineer-in-charge. Manufacturer's recommended installation methodology shall be adopted for installation. The Contractor is to take approval of the sheet profile, design and installation methodology before installation of the sheets from the concern authorities. The installation includes profiled sheet, capping, trims, flashing and all type of accessories considered for the installation of items. The installation measurement shall be based on finished surface area.

Test: The sheet shall be tested before use to check the basic metal thickness, coating mass & tensile strength by appropriate testing method in the approved laboratory and cost for the testing shall be borne by the Contractor.

Khur ra: shall be of 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1mx1mx400micron, finished with 12mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges.

At inlet mouth of rain water pipe, cast iron grating 15 cm diameter and weighing not less than 440 grams shall be provided.

Rain Water Pipes - All the RWP pipes shall be PVC Pipes (including with required fittings and clamps) exposed on walls / in the shafts to be executed as per CPWD specification 2009.

SHINGLES ROOF FINISHING

Laying of roofing shingle including preparation of surface as required for treatment of roofing shingles, under laying membrane & nails consisting of following operations systems with nailing method:

Applying a Bitumen Prime Coating is intended for preparation of the surface before installation of self-adhesive sealant tape waterproofing material width 5cm. The primer presents a mix of high-quality bitumen and specially selected organic solvents. It has an enhanced covering mass fraction of non-volatile substances 45-55% , relative viscosity 15-40s, consumption 0.25-0.35Lit per sqm bucket volume 3,10,30 and bitumen primer should be allowed to dry for a minimum of 6 to 8 hours to ensure proper adhesion of subsequent layers including cleaning the surface before treatment.

Laying of HIP and Ridge/Starter SBS modified, high-end, factory-made ridge called HIP and Ridge/Starter with the help of the nailing method and ensure the standard area assumption base layer fiber class 110, SBS bitumen type, Flow resistance at elevated temperature 100°C, 3.4±0.2 mm Thickness per layer, 5.5 kg per sqm weight, Installation

method a/c and as directed and specified by the The Engineer.

Applying High Definition, Laminated Asphalt-based roofing shingles called "Country Series of Shingles Brand" (having 50 years warranty and weight of 12 kg per sqm) with the help of the nailing method. Shingles Brand's "Country Series" roofing shingles offer long durability with a significant weight. The shingles should be securely nailed to the surface for proper fixation. Roofing shingles for its strict requirements for the minimum mass of bitumen in products 1300 g/m² for laying roofing shingles and as directed and specified by the Engineer-in-Charge.

2.15. FINISHING WORK:

All External AAC walls shall be finished with 18 mm cement plaster in two coats under layer 12 mm thick cement plaster 1:5 (1 cement : 5 coarse sand) and a top layer 6 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished rough with sponge and all internal AAC walls shall be finished with 12 mm (average) finished (1:4) thick cement plaster. The Contractor is free to use ready-mix plaster of approved make in place of cement plaster and nothing extra shall be paid on this account at all floors and locations, finished in smooth line and level etc. complete.

All brick wall shall be finished with 12mm (1:6) thick cement plaster and 15mm (1:6) cement plaster on rough side. The Contractor is free to use ready-mix plaster of approved make in place of cement plaster and nothing extra shall be paid on this account. No plastering to be done at Ceiling.

Chicken mesh 24 gauge 19 mm size galvanised chicken wire mesh of approved make and design to be provided at junctions of RCC or CC members and brick work and other locations including necessary clips and "U" nails rawl plugs,screws etc. complete for all height as per specifications & direction of the Engineer-In-Charge.

Necessary drip course shall be provided in Chajja, Balcony, Projecting Roof, Beams etc.

All the internal surfaces including exposed ceiling (non false ceiling areas) shall be finished with 1 mm thick cement based wall putty, one coat of cement primer and two or more coats of paints specified in finishing schedule.

Application of paints shall be done with mechanical equipment's. Mechanical sanding machine (for scrubbing & preparation of surface) shall be used by the Contractor.

In case of painting over old work / new work, the Contractor shall give proper notice to the The Engineerafter the surface is prepared & before applying of primer coat / paint. The The Engineershall either approve the surface thus prepared or ask the Contractor to rectify the defects pointed. Only after approval by Engineer-in-charge, the priming / painting coat shall be applied.

Oil Emulsion (Oil Bound) Washable Distemper:

Oil emulsion (Oil Bound) washable distemper (IS 428) of approved brand and manufacture shall be used. The primer where used as on new work shall be cement primer or distemper primer as described in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer.

Only sufficient quantity of distemper required for day's work shall be prepared. The distemper and primer shall be brought by the Contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the Contractor and the Engineer-in-Charge. The empty tins shall not be removed from the site of work, till this item of work has been completed and passed by the Engineer-in-Charge. Preparation of the Surface For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc. Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine grade sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

Application:

Priming Coat : The priming coat shall be with distemper primer or cement primer, as required in the description of the item.

Note : If the wall surface plaster has not dried completely, cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied. Oil bound distemper is not recommended to be applied, within six months of the completion of wall plaster. However, newly plastered surfaces if required to be distempered before a period of six months shall be given a coat of alkali resistant priming Paint conforming to IS 109 and allowed to dry for atleast 48 hours before distempering is commenced. For old work no primer coat is necessary. Distemper Coat : For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitutes one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat. For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade. 15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be tho-roughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

Water Proofing Cement Paint:

Base coat of water proofing cement paint The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work. The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade. For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

Precaution:

Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the The Engineershall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible

leaving no brush marks.

Scaffolding:

Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed. For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Note: In case of special type of brick work, scaffolding shall be got approved from Engineer-in Charge in advance. Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

Exterior Painting On Wall: Textured & 2 coat putty + primer + Acrylic Emulsion Paint up to fasle ceiling plus100mm height + above false ceiling white washing

Material: The paint shall be (Texured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint/100% premium 2 coat putty + primer + Acrylic Emulsion Paint up to fasle ceiling plus100mm height + above false ceiling white washing) of approved brand and manufacture. This paint shall be brought to the site of work by the Contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fornight's work. The materials shall be kept in the joint custody of the Contractor and the Engineer-in- Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface:

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the The Engineer after inspection before painting is commenced.

Putty:

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material conforming to IS 345 with same shade as Paint shall be used where specified. The surface treated for knotting shall be dry before Paint is applied. After obtaining approval of Engineer- in-Charge for wood work, the priming coat shall be applied before the wood work is fixed in position. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glazier's putty or wood putty. Stopping shall

not be done before the priming coat is applied as the wood will absorb the oil in stopping and the latter is therefore liable to crack.

Acrylic Distemper:

1st quality acrylic distemper having VOC content less than 50 gms/litre of approved brand and manufacture shall be used. The acrylic distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for day's work shall be prepared.

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

Preparation of the Surface For new work the surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc.

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

Application:

In the case of new work, the treatment shall consist of a priming coat of whiting followed by the application of two or more coats of distemper till the surface shows an even colour. For old work, the surface prepared as described shall be applied one or more coats of distemper till the surface attains an even colour.

The application of each coat shall be as follows:

The entire surface shall be coated with the mixture uniformly, with proper distemper brushes (ordinary white wash brushed shall not be allowed) in horizontal strokes followed immediately by vertical ones which together shall constitute one coat. The subsequent coats shall be applied only after the previous coat has dried.

The finished surface shall be even and uniform and shall show no brush marks. Enough distemper shall be mixed to finish one room at a time. The application of a coat in each room

shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day. After each day's work, the brushes shall be washed in hot water and hung down to dry. Old brushes which are dirty or caked with distemper shall not be used. Note : If the wall surface plaster has not dried completely, cement primer shall be applied before distempering the walls. But if distempering is done after the wall surface is dried completely, distemper primer shall be applied. For old work no primer coat is necessary.

Distemper Coat : For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitutes one coat. The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat. For old work the distemper shall be applied over the prepared surface in the same manner as in new work. One or more coats of distemper as are found necessary shall be applied to obtain an even and uniform shade. 15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be tho-roughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work

Synthetic Enamel Paint : All the steel work shall be applied two or more coats of synthetic enamel paint over a coat of suitable primer of approved brand and manufacture with ready mixed red oxide zinc chromatic on steel / iron works having VOC content less than 250 grams/litre.

Water repellant coat: 2 to 3 coats of Silicone based water repellant, anti-algal paint of approved shade, complete as per manufacturer's specifications, shall be applied on stone cladding.

Anti-Bacterial Paint: Low VOC, highly washable, water based, abrasion resistant (over 4000 cycles) sanitizing and anti-bacterial coating Ultra satin (D-11205) shall be applied as per finishing schedule to all kind of surface and enhancing protection against bacteria for Hygienic environment and conforming to JIS Z 2801:2100 test Protocols for Anti- Bacterial Coatings test. The material should be reactive curing acrylic resin water based coating. One coat of water based acrylic primer shall be applied before application of two coats of water based anti-bacterial coating.

Gomusa Elevation finishing

FR GRADE - FRP PANEL - Providing and Fixing of Pre Pigmented To Desired Colour - FRP (Fibre Reinforced polyester resin plastic composite)Panels in 5 mm thick finished , weight 8.5 Kg/Sqm, fire rating Class B as per ASTM E 84,size, pattern, design, and colour of approved make to be fixed on brick / RCC / Block work Column or structural steel work

with Dry Fixing method with all appropriate , fasteners for fixing, and necessary hardware on Façade. The panel shall be made from materials UV Resistant, abrasion resistance . The panel shall be securely fixed to the available surface of required size at specified locations. This includes the cost of screen, , anchor fasteners, labour charges for fixing, for all heights in the elevation. - As Per Layer By Layer Technique Used By GFRC Facades - Panel

2.16. STAINLESS STEEL WORK:

Unless otherwise specified, stainless steel generally shall be of Grade (SS 304) or 1.4401 (SS 316). Stainless Steel (SS) grade 316 shall be used for exposed / exterior work whereas grade SS 304 shall be used for interior works. Lower grades shall not be used. Before taking up any procurement/construction activity, shop drawings shall be prepared and submitted for obtaining approval from Engineer-in-Charge.

Stainless steel railing shall be provided with SS 304 grade stainless steel of 50 mm dia. of 18 gauge handrail with adequate rods parallel to handrail, balusters, flanges, end caps, newel posts with caps etc. complete as per approved drawings and direction of Engineer–in–charge.

Surface finish of all the stainless steel materials will be in 240 grit satin finish / matt finish. All stainless steel material will have to be coated by a solution of Inox to avoid finger in prints and avoidance of settlement of environment / atmospheric dust. Stainless steel railing, both sides in staircase and external ramp with double handrail shall be used for barrier free accessibility requirements with adequate SS balusters, runners etc as per approved architectural drawing. Fixing shall be done by stainless steel expansion bolts of approved size and make as per Engineer-in- Charge and welding to be done by using organ welding rods and the surface being duly finished and cleaned by K2 passivation, which is nitric acid plus floric acid solution treatment by which the chances of corrosion will be eliminated and any burn out makes on the metal will also be eliminated.

2.17. STRUCTURAL STEEL WORK :

Scope of work for the Contractor in respect of structural steel work shall cover, but shall not be limited to the following:

(i) Structural steel work shall cover all composite structural works consisting of structural steel and RCC in combination. It shall also cover steel trusses and misc structural steel frameworks.

(ii) Preparation and submission of complete detailed shop fabrication drawings based on the architectural and structural design and drawings including revision in same as per directions of Engineer-in-charge.

(iii) Submission of shopn drawings, with calculations and detailed fabrication drawings, in case any substitution is required in the designed sections with prior approval of The Engineer. No shop fabrication will be executed without prior

approval of the above from The Engineer .

(iv) Submission of detailed erection plan/methodology for all structural members of structural steel structure, compatible with the details of fabrication. Also complete drawings & phase wise instructions for all the activities required to erect steel structure in final position, shall be submitted.

(v) Submission of shuttering, staging and scaffolding details for casting of deck slab over the erected "Steel Plate Girders".

(vi) Submission of details of specialized agency for steel fabrication in workshop and erection at site of structural steel work, which the Contractor propose to associate for structural steel work. The agency for fabrication of steel members in workshop and agency for erection of these steel members at site should preferably be same. The specialized agency should satisfy the experience requirements as stipulated in bid document elsewhere. Details should include experience of specialized agency in similar structural steel works, financial capabilities, location of workshop, fabrication facilities available in fabrication workshop etc.

(vii) Procurement and testing of all raw structural steel materials in lots for fabrication taking into account wastage margin etc., including storage and upkeep of the materials

(viii) Providing all materials, labour, tools & plant and equipment's and all types of consumables required for fabrication using Gas Metal Arc welding (MIG welding) or Submerged arc welding including all necessary bolts, nuts, washers with wastage margins.

(ix) Fabrication of the steel works in accordance with the approved fabrication drawings, including all shop assembling, matching and marking. Design, manufacture/fabrication and provision of all jigs, fixings, manipulators etc. required for the fabrication.

(x) Suitably marking, bundling and packing for transport of all fabricated materials.

(xi) Preparing and furnishing detailed bill of materials, drawing Office dispatch lists, Bolts

(xii) Lists and any other lists of bought out items required in connection with the fabrication of the structural steelwork.

(xiii) Loading and transporting all fabricated steelwork and field connection materials including site unloading and erection of structure in final position with all bolts, nuts, insert plate etc.

(xiv) The Contractor shall provide general assistance during complete erection for solving any problem related to fabrication or site assembling of the structural steelwork. The Contractor shall ensure the presence of the qualified and experienced Erection Engineer during complete erection work at site.

(xv) All major/ minor modifications of the fabricated steel structures, as directed by the Engineer-in-charge, including but not limited to the following:

(xvi) Removal of bends, kinks, twists etc. for parts damaged during transportation and handling.

(xvii) Cutting, chipping, filling, grinding etc. if required or preparation and finishing of site connections.

(xviii) Reaming of holes for use of higher size bolt if required.

(xix) Re-fabrication of parts damaged beyond repair during transport and handling or re- fabrication of parts which are incorrectly fabricated.

(xx) Fabrication of parts omitted during fabrications by error, or subsequently found necessary.

(xxi) Drilling of hole, with prior approval of Engineer-in-charge, which are either not drilled at all or are drilled in incorrect location during fabrication. Drilling of holes for connections of all structural members shall otherwise be done in fabrication workshop only.

(xxii) Carry out tests in accordance with the related Specification which will be inspected by Engineer-in-charge.

(xxiii) Details of erection equipment machinery including capacity & specifications, tools, tackle etc. to be used for erection purpose.

(xxiv) Necessary formwork & staging required for erection of structural members including design of formwork for all the anticipated loads.

(xxv) All procedures and tests on welds as per specifications and welded parts to ensure the strength requirements of joints.

Submittals: On commencement of the work pertaining to steel structure, the Contractor shall submit the following in two sets:

a. Detailed baseline program, material procurement schedule, shop/working drawings, submission of samples, process/methodology of fabrication & delivery to site storage yard and erection at site for the approval of the Engineer-in-charge.

b. Complete fabrication drawings, schedule of quantity, cutting lists, bolt lists, welding schedules.

c. Results of any tests, as and when conducted and as required by the Engineer-in-charge.

d. Manufacturer's mill test reports/certificates in respect of steel materials, bolts, nuts and electrodes etc. as may be applicable.

e. A detailed list of all Plant & Equipment such as cranes, derricks, winches, welding sets, all consumables, grinding and hole drilling machine etc. their

make, model, present condition and location, available to the Contractor and the ones he will employ on the job to maintain the progress of work in accordance with the contract.

f. The total number of experienced personnel of each category like fitters, welders, riggers etc., which he intends to deploy on the project.

The The Engineer reserves the right to make changes in the design drawings even after release for preparation of shop drawings to reflect addition, omission & modifications in data/details and requirements. Contractor shall consider such changes as part of these Specifications and the contract and no extra claims shall be entertained on this account.

Design and drawings will show as appropriate the salient dimensions of structural members. Design loads, if needed shall be made available. Any other relevant information required for the preparation of fabrication drawings, designs and erection details shall be provided to Contractor by Engineer-in-charge.

It shall be clearly understood that the drawings provided to the Contractor will be design drawings. The typical details of connection, cuts, gusset plate shapes notches, bends, etc. wherever shown in the design drawings are only for general guidance of the Contractor. The Contractor shall develop all such details based on the design drawings.

In case of variations in design drawings and specifications, the decision of the The Engineershall be final. Should the Contractor, find any discrepancy in the information furnished to him, same shall be immediately brought to the notice of The Engineerfor resolution. The Contractor shall obtain clarifications on discrepancies from The Engineerbefore proceeding with the work.

No detailed shop drawings will be accepted for examination by the The Engineerunless these have first been completely checked by the Contractor's qualified structural engineer and PMC’s structural engineer. The Contractor shall check and ensure that detailing of connections is carefully planned to obtain ease in erection of structures, including field bolting or field connection of temporary structure to permanent structure. Any temporary structure which is used for erection or launching purpose and required to be welded to permanent structural works shall be accounted for in fabrication drawings. Permission shall be obtained before welding or holing is done in permanent structures other than as shown in design drawings or approved fabrication drawings. In case of field bolted connection between temporary structure and permanent structural works, all necessary holes provision shall be left during fabrication in shop.

No fabrication work shall be started by the Contractor without approval of The Engineeron the relevant drawings. Approval by the Engineer-in- charge of any of the drawings shall not relieve the Contractor of his responsibility of workmanship, fit of parts, details, materials and errors or omissions of any work.

The Contractor shall furnish three sets of prints of shop drawings as advance drawing (for

approval) and four set of prints of all approved final shop drawings along with soft copy in CD/pen drive for field use and record purpose.

The Contractor shall specify the name of workshop where he intends to get the fabrication work carried out. The fabrication shop should have facility for at least Automatic continuous submerged arc H beam welding machine, Automatic paint conveyer system, Max Seam roofing System, shearing machine, CNC plasma machine, pug mill, edge beveling machine, flame cutting machine, grinders, sand blasting equipment's, facilities for lifting and handling of large span and heavy structural members etc.

The drawings prepared by the Contractor and all subsequent revisions thereof shall be at the cost of the Contractor and no separate payments shall be made for the same. Revisions shall incorporate all modifications, field changes, substitutions etc. effected.

The Contractor shall give due consideration to the need of trial assemblage at shop, weight and size limitation of elements for transportation from shop to site storage yard/Erection site, temperature variation of 25 degree centigrade between the fabrication shop and site, site measurements of as-built dimensions and position of pockets etc. for bolts and avoidance of site welding except for fixtures.

All the drawings shall be prepared in metric units. The drawings should preferably be of A-2 or A- 1 standard size, and the details shown therein shall be clear and legible. These drawings shall include but shall not be limited to the following:

a. Assembly drawings, giving exact sizes of the sections to be used and identification marks of the various sections members.

b. Dimensional drawings of base plans, anchorage detail of bearing bolts location etc.

c. Complete quantity schedule of materials and detailed drawings of all sections.

d. Detailed shop drawings for proper co-ordination with the concrete components to which thesteel members shall be connected, as required.

e. Any other drawings or calculations that may be required for proper completion of the works and clarification of the works or substituted parts thereof.

f. All 'as-built' drawings in 4 prints and 1 plot on Garware film or equivalent and on CD.

Applicable Codes of Practice:

The following specifications, standards and codes of practice are included as part of this Specification-

1. IS: 226 Structural Steel (Standard Quality)
2. IS: 800 (1984) Code of Practice for General Construction in Steel.

3.	IS: 808 (1989)	Dimensions for Hot Rolled Steel Beam, Column, Channe and Angle Sections
4.	IS: 813	Scheme of Symbols for Welding
5.	IS: 814 (1991)	Covered Electrodes for Manual Metal Arc Welding of Carbon & Carbon -Manganese Steel.
6.	IS: 815	Classification Coding of Covered Electrodes for Metal Arc Welding of Structural Steel
7.	IS: 816 (1969)	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.
8.	IS: 817 (1969)	Code of Practice for Training and Testing of Metal Arc Welders.
9.	IS: 822	Inspection of Welded Connection
10.	IS: 823	Specification for Workmanship of Steel Structure
11.	IS: 919 (1993)	ISO System of Limits & Fits (Part 1 & Part 2)
12.	IS: 961	Structural Steel (High Tensile)
13.	IS: 1024	Code of Practice for use of Welding in Bridges and Structures subject to Dynamic Loading
14.	IS: 1148 (1982)	Hot Rolled Rivet Bars (upto 40mm) for Structural Purposes.
15.	IS: 1161	Steel Tubes for Structural Purposes
16.	IS: 1182 (1983)	Recommended Practice for Radio Graphic Examination of Fusion Welded Butt Joints in Steel Plates.
17.	IS: 1363 (1992)	Hexagon Head Bolts, Screws and Nuts of Product grade C (Part 1 to Part 3)
18.	IS: 1364 (1992)	Hexagon Head Bolts, Screws and Nuts of Product Grades A & B (Part 1 to 5)
19.	IS: 1367 (1991)	Technical Supply Conditions for Threaded Steel Fasteners.
20.	IS: 1852 (1985)	Rolling & Cutting Tolerances for Hot-Rolled Steel Product.
21.	IS: 1977 (1975)	Structural Steel (Ordinary Quality).
22.	IS: 2016 (1967)	Plain Washers.
23.	IS: 2062 (1992)	Steel for General Structural Purposes.
24.	IS: 2595 (1978)	Code of Practice for Radio Graphic Testing.
25.	IS: 3600 (1985)	Methods of Testing Fusion Welded Joints (Part 1 to Part 9)
26.	IS: 3613 (1974)	Acceptance Tests for Wire Flux Combinations for Submerged Arc Welding.
27.	IS: 3658 (1981)	Code of Practice for Liquid Penetrant Flow Detection.
28.	IS: 3757 (1985)	High Strength Friction Grip Bolts
29.	IS:4000 (1992)	High Strength Friction Grip Bolts in Steel Structures-Code of Practice
30.	IS:4353 (1967)	Recommendations for Submerged Arc Welding of Mild Steel and Low Alloy Steel.

31. IS: 4923 Hollow Steel Sections for Structural Use
32. IS: 4943 (1968) Assessment of Butt and Fillet Fusion Welds in Steel Sheet, Plate and Pipe.
33. IS: 5334 (1981) Code of Practice for Magnetic Particle Flow Detection of Welds
34. IS: 5369, 5370 General Requirements for Plain Washers and Lock Washers(1975)
35. IS: 5372 (1975) Taper Washers for Channels
36. IS: 6610 Heavy Washers for Steel Structures
37. IS: 5374 (1975) Taper Washers for I Beams.
38. IS: 6227 Code of Practice for Use of Metal Arc Welding in Tabular Sections
39. IS: 6623 (1985) Specification for High Strength Structural nuts
40. IS:6649 (1985) Specifications for hardening and tempering washers for high strength structural nuts
41. IS: 6755 (1980) Double Coil Helical Spring Washers.
42. IS: 7215 (1974) Tolerances for Fabrication of Steel Structure.
43. IS: 7205, 7273, Safety Requirements for Steel Construction
44. IS: 7269, 7293 Handling of materials & Equipment's for Safe Working
45. IS: 7307 (Part I) Destructive & Non-Destructive Test of Welds
46. IS: 7318 (1974)(Part I) Approval Tests for Welders When Welding Procedure Approval is not required -fusion Welding of Steel.
47. IS:8500 (1991) Structural steel -Micro alloyed (Medium and High Strength Qualities)
48. IS: 8613 Wise Flux Combinations for Welded Joints
49. IS:8910 (1978) General requirements of Supply of Weldable Structural Steel.
50. IS: 9595 (1980) Recommendations for Metal Arc Welding of Carbon & Carbon-Manganese Steels.
51. IS: 12843 Tolerances for Erection of Structural Steel Works
52. IRC: 24:Section V Standard Specifications and code of Practice for Road Bridges: Steel Road Bridges
53. 51 IRC:22-1986 Standard specification for road bridges

Section VI – Composite construction

Materials

a. All materials to be supplied by the Contractor shall conform to relevant Indian Standards as approved by the Engineer-in-charge.

b. Structural Steel materials required for the work shall be free from imperfections, mill scales, slag intrusions, laminations, pitting, rusts etc. that may im-pair strength, durability and appearance. All materials shall be of tested quality only. Test Certificates in respect of each consignment shall be submitted to The Engineerbefore use in work. Whenever the materials are permitted for procurement from identified stocks, a random sample shall be tested at an approved laboratory, as directed by the Engineer-in-charge.

c. Structural steel encased column shall be in high tensile steel with a yield stress of 450 MPA conforming to IS: 2062. Structural steel beam shall be built up section in high tensile steel with yield stress of 450 MPA conforming to IS: 2062. UB/ UC sections shall be of yield stress of 350 MPA; for ISMB/ISMC/ ISA sections, the steel shall have yield stress of 250 MPA. Deck sheet shall be comflor-60, TR-60 or equivalent of 1mm thick with yield stress of 350 MPA with minimum 275 GSM galvanization of approved make. Shear studs shall have Ultimate stress of 450 MPA. Unless otherwise specified all anchor bolts shall be of property class of 8.8 (and size M40) and shall conform to IS: 1363 (1992), IS: 1364 (1992) and IS:1367, as applicable. Unless specified otherwise, head of bolts shall be hexagonal. All nuts shall conform to property class compatible with the property class of the bolt used. Unless specified otherwise, on drawings washer for HSFG/ High Strength bolts shall be conforming to IS:6649 (1985). Also plain washers shall be conforming to IS:5369 (1975).

Storage of Materials:

a. All materials shall be so stored as to prevent deterioration, and to ensure the preservation of their quality and fitness for the work. If required by the Engineer-in-charge, the materials shall be stored under cover and suitably painted for the protection against weather condition. Any material, which has deteriorated or has been damaged shall be removed from site and replaced by new members, as directed by the The Engineerat no extra cost and time.

b. The steel to be used in fabrication shall be stored in a separate stack clear of the ground section wise and lengthwise.

c. The storage area shall be kept clean and properly drained. Structural steel shall be so stored and handled in such a manner that members are not subjected to excessive stresses and damage. Girders and beams shall be

placed in upright position. Long members shall be supported on closely spaced skids to avoid unacceptable deflection.

d. The Contractor shall have a suitable shop storage yard at his own premises for storing the fabricated steel structures and other materials. The yard shall have proper facilities such as drainage and lighting including access for cranes, trailers and other heavy equipment's.

e. All Shop / field connection materials, shop paints etc. shall be stored on racks and platforms, off the ground in a properly covered building by the Contractor.

f. The Contractor shall make proper arrangement for sand blasting of steel sections so that these sand blasted materials may be used for fabrication wherever required.

Handling and Storing of Materials:

a. Suitable area for storage of structures and components shall be located near the site of work. The access road should be free from water logging during the working period and the storage area should be on leveled and firm ground.

b. The store should be provided with adequate handling equipment's e.g. road mobile crane, gantries, derricks, chain pulley blocks, winch of capacity as required. Stacking area should be planned and have racks, stands sleeper, access tracks, etc., and properly lighted.

c. Storage should be planned to suit erection work sequence and avoid damage or distortion. Excessively rusted, bent of damaged steel shall be rejected. Methods of storage and handling steel, whether fabricated or not shall be subject to the approval of the The Engineer.

d. Fabricated materials are to be stored with erection marks visible, such as not to come into contact with earth surface or water and should be accessible to handling equipment.

e. Small fitting hand tools are to be kept in containers in covered stores.

f. All materials, consumables, including raw steel or fabricated material shall be stored specification-wise and size-wise above the ground upon platforms, skids or other supports. It shall be kept free from dirt and other foreign matter and shall be protected as far as possible from corrosion and distortion. The electrodes shall be stored specification-wise and shall be kept in dry warm condition in properly designed racks. The bolts, nuts, washers and other fasteners shall be stored on racks above the ground with protective oil coating in gunny bags. The paint shall be stored under cover in air-tight containers.

g. IS:7293 and IS:7969 dealing with handling of materials and equipment's for safe working should be followed. Safety nuts and bolts as directed are to be used while working. The Contractor shall be held responsible for loss or damage to any material provided by the Department while in his care or for any damage to such material resulting from his work.

Shop Assembly: The steelwork shall be temporarily shop assembled, as necessary, so that the accuracy of fit may be checked before dispatch. The parts shall be shop assembled with a sufficient number of parallel drifts to bring and keep the parts in place. Since parts drilled or punched, with templates having steel bushes shall be similar and, as such, interchangeable, such steelwork may be shop erected in part only, as agreed by the Engineer-in-charge.

Erection Marking: Each fabricated member, whether assembled prior to dispatch or not so assembled, shall bear an erection mark, which will help to identify the member and its position in respect of the whole structure, to facilitate re-erection at site. These erection marks shall be suitably incorporated in the shop detail and erection drawings.

Formwork: The formwork shall be properly designed, substantially built and maintained for all anticipated loads. The Contractor, if required, shall submit plans for approval to the The Engineer. Approval of the plans, however, shall not relieve the Contractor of his responsibility.

Assembling :

a. The parts shall be accurately assembled as shown on the drawings and match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surface or surfaces to be in permanent contact shall be cleaned, before the members are assembled.

b. The truss spans shall be erected on blocking, so placed as to give the proper camber. The blocking shall be left in place until the tendon chord splices are fully riveted and all other truss connections pinned and bolted. Bolts in splices of butt joints of compression members and bolts in railings shall not be driven until the span has been swung.

c. All joint surface for bolted connections including bolts, nuts, washers shall be free from scale, dirt, burrs, other foreign materials and defects that would prevent solid seating of parts. The slope of surface of bolted parts in contact with bolt head and nut shall not exceed 1 in 20, plane normal to bolt axis, otherwise suitable tapered washer shall be used.

d. All fasteners shall have a washer under nut or bolt head whichever is turned in tightening.

e. Any connection to be bolted shall be secured in close contact with service bolts or with a sufficient number of permanent bolts before the rivets are driven or before the connections are finally bolted. Joints shall normally be

made by filling not less than 50 percent of holes with service bolts and barrel drifts in the ratio 4:1. The service bolts are to be fully tightened up as soon as the joint is assembled. Connections to be made by close tolerance bolts shall becompleted as soon as practicable after assembly.

Transportation & Handling

a. Before the shop assembling is dismantled, all members and sections shall be appropriately marked with paint or grooved with their identification numbers as detailed in shop drawings.

b. The Contractor shall transport the fabricated structural steel materials to work site, with all necessary field connection materials, in such sequence as will permit the most efficient and economical performance of the erection work. As per scheduled programme, the Engineer- in-charge may, at his discretion prescribe or control the sequence of delivery of materials.

c. Fabricated parts shall be handled in such a way-that no damage is caused to the components. Measures shall be taken to minimize damage to the protective treatment on the steelwork. All work shall be protected from damage in transit. Particular care shall be taken to stiffen free ends, prevent permanent distortion and adequately protect all machined surfaces. All bolts, nuts, washers, screws, small plates and articles generally shall be suitably packed and identified.

Field Bolts:

a. Contractor shall supply the full number of bolts, nuts and washers and other necessary fittings required completing the work, together with the additional bolts, nuts and washers totaling to 10% of the requirement subject to minimum of 10 Nos.

b. At the time of assembly, the surfaces in contact shall be free of paint or any other applied finish, oil, dirt, loose rust, loose scale, burrs and other defects which would prevent solid seating of the parts or would interfere with the development of friction between them.

c. If any other surface condition, including a machined surface, is specified, it shall be the responsibility of the Contractor to work within the slip factor specified for the particular case.

d. Each bolt and nut shall be assembled with washers of appropriate shape, quality and number in cases where plane parallel surfaces are involved. Such washers shall be placed under the bolt head or the nut, whichever is to be rotated during the tightening operation. The rotated nut or bolt head shall be tightened against a surface normal to the bolt axis, and the appropriate tapered washer shall be, used when the surfaces are not parallel. The angle between the bolt axis and the surface under the non-rotating component (i.e. the bolt head

or the nut) shall be 90 + 3 degree. For angles outside these limits, a tapered washer shall be placed under the non-rotating component. Tapered washers shall be correctly positioned.

e. No gasket or other flexible material shall be placed between the holes. The holes in parts to be joined shall be sufficiently well aligned to permit bolts to be freely placed in position. Driving of bolts is not permitted. The nuts shall be placed so that the identification marks are clearly visible after tightening. Nut and bolts shall always be tightened in a staggered pattern and where there are more than four bolts in any one joint, they shall be tightened from the centre of the joint outwards.

f. If, after final tightening, a nut or bolt is slackened off for any reason, the bolt, nut and washer or washers shall be discarded and not used again.

Tightening of bolts:

a. Bolted connection joints with high strength friction grip bolts shall be inspected for compliance of codal requirements.

b. The Engineer shall observe the installation and tightening of bolts to ensure that correct tightening procedure is used and shall determine that all bolts are tightened. Regardless of tightening method used, tightening of bolts in a joint should commence at the most rigidly fixed or stiffest point and progress towards the free edges, both in initial snugging and infinal tightening.

c. The tightness of bolts in connection shall be checked by inspection wrench, which can be torque wrench, power wrench or calibrated wrench. Tightness of 10 per cent bolts, but not less than two bolts, selected at random in each connection shall be checked by applying inspection torque. If no nut or bolt head is turned by this application, connection can be accepted as properly tightened, but if any nut or head has turned all bolts shall be checked and, if necessary, re-tightened.

Erection of Steel Structures:

a. The Contractor shall erect the structural steel, remove the temporary construction, and do all the work required to complete the, construction included in the contract in accordance with the drawings and the specifications and to the entire satisfaction of the Engineer.

b. The Contractor shall submit erection plans prepared by the fabricator, showing a method and procedure of erection, compatible with the details of fabrication.

c. A detailed scheme must be prepared showing stage-wise activities, with complete drawings and working phase-wise instructions. This should be based on detailed stagewise calculation and take into account specifications

and capacity of erection equipment machinery, tools, tackles to be used and temporary working loads as per Codal provisions.

i. The scheme should be based on site conditions e.g. hydrology, rainfall intensity, soil and sub-soil conditions, temperature and climatic conditions and available working space, etc.

ii. The scheme should indicate precisely the type of temporary fasteners to be used as also the minimum percentage of permanent fasteners to be fitted during the stage erection. The working drawings should give clearly the temporary jigs, fixtures, clamps, spacer supports, etc.

iii. The Contractor shall supply and erect all necessary false work and staging and shall supply all labour, tools, erection plant and other materials necessary to carry out the work complete in all respects.

iv. Prior to actual commencement of erection all equipment, machinery, tools, tackles, ropes, etc. need to be tested to ensure their efficient working. Frequent visual inspection is essential in vulnerable areas to detect displacements, distress, drainages, etc.

v. Deflection and vibratory tests shall be conducted in respect of supporting structures, launching truss, cranes etc. as also the structure under erection and unusual observations reviewed, looseness of fittings are to be noted.

vi. For welded structures, welders' qualifications and skill are to be checked as per standard norms. Non-destructive tests of joints as per The Engineer's directives are to be carried out.

vii. Safety requirements should conform to IS: 7205, IS:7273 and IS:7269 as applicable and should be a consideration of safety, economy and rapidity.

viii. Erection work should start with complete resources mobilized as per latest approved drawings and after a thorough survey of foundations and other related structural work. In case of work of magnitude, maximum mechanization is to be adopted.

ix. The structure should be divided into erectable modules as per the scheme. This should be pre-assembled in a suitable yard/platform and its matching with members of the adjacent module checked by trial assembly before erection.

x. The structure shall be set out to the required lines and levels. The stocks and masses are to be carefully preserved. The steelwork should be erected, adjusted and completed in the required position to the specified line and levels with sufficient drifts and bolts. Packing materials are to be available to maintain this condition. Organized

"Quality Surveillance" checks need to be exercised frequently.

xi. Before starting work, the Contractor shall obtain necessary approval of the Engineer as to the method adopted for erection, the number and character of tools and plants. The approval of the Engineer shall not relieve the Contractor of his responsibility for the safety of his method or equipment or from carrying out the work fully in accordance with the drawings and specifications.

xii. During the progress of work, the Contractor shall have a competent Engineer or foreman in charge of the work, who shall be adequately experienced in steel erection and acceptable to the The Engineer.

Painting at Site:

a. Surfaces which will be inaccessible after site assembly shall receive the full specified protective treatment before assembly. Surfaces which will be in contact after site assembly shall receive a coat of paint (in addition to any shop primer) and shall be brought together while the paint is still wet. Damaged or deteriorated paint surfaces shall be first made good with the same type of coat as the shop coat. Where steel has received a metal coating in the shop, this coating shall be completed on site so as to be continuous over any welds, bolts and site rivets. Specified protective final painting treatment shall be completed after erection.

b. All the structural steel members (Beams/Columns/Slabs/Truss etc.) consist of members both of built up sections by steel plates as well as of standard sections of various sizes shall be applied with single pack factory blended (free from asbestos & Glass fibers) vermiculite and Portland cement based, fire resistant material mixed with the required solvent/ water and designed for the fire protection of interior/exterior structural steel members as per manufacturer design & specification to required thickness sufficient to obtain minimum 3 Hour fire rating (as per NBC 2016). The exposed visible areas should be trowel finish. The plaster application shall be carried out through certified applicator / licensee of the manufacturer. The product shall adhere to the steel surface and should comply with latest provisions contained in UL-263 and BS-476 part 20/21 (for load bearing section). Before applying the material on surface of structural member, any metal mesh required to bond the material should be applied as per manufacturer specification. All lots / bags of blended material should have certification stamp from independent third party laboratories like Warrington Fire Research Lab (UK)/ UL (USA). (Approved make: NEWKEM / GRACE).

Structural SteelworkSpecification for Welded Structure:

a. The Steel structure should be made from Automatic continuous submerged arc H beam welding machine and shall be factory primer/ painted on Automatic paint conveyer system.

b. This Specification covers the supply, fabrication transportation and erection at site of welded structural steelwork, including the supply of approved consumables, electrodes, wires and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the Specification. The shear connectors' studs as specified in the drawing shall also be welded in the shop.

c. Workmanship: All workmanship shall be in accordance with the best practices in modern structural steel works. Accuracy shall be maintained in the manufacture of every part of the work. The Contractor shall not proceed with any welding until the The Engineerhas approved his welding plan, which shall include all information's on welding procedures, equipment, additives and preheating during welding operation, Details of non - destructive testing methods, Precautions with regard to welding shrinkage, Possible treatment of completed welds by grinding, Procedure and programme of welding sequence etc.

d. Templates: Templates used throughout the work shall be of Steel. In cases where actual materials have been used as templates for drilling similar pieces, the The Engineershall decide whether such materials are fit to be used as parts of the finished structure.

e. Straightening: All materials shall be straight and free from twists, and if necessary, before being worked, shall be straightened and/or flattened by pressure, unless required to be of curvilinear form. Fusion faces and the surrounding surfaces within 50mm of the welds shall be free from all mill scale and free from oil, paint or any substance which might affect the quality of the welds or impede the quality/progress of welding. These shall be free from irregularities, which would interfere with the deposition of the specified size of weld or be the cause of defects. All mill scale within 50mm of welds shall be removed prior to welding, either by pickling followed by thorough power wire brushing, or by other approved methods. If preparation or cutting of the fusion faces is necessary, the same shall be carried out by shearing, chipping, gas cutting or flame gouging. Where hand gas cutting or hand gouging is employed, the blowpipe or gouging blowpipe shall be properly guided.

f. Shearing, Cutting and Planning: Cutting shall be done automatically. Cutting by shearing machine may be used for plates not exceeding 10 mm in thickness provided that the plate edges be fully enclosed in a weld. For

Plates above 10mm, CNC plasma cutting shall be used provided a smooth and regular surface free from cracks and notches is secured. Chipping of edges of plates, wherever necessary, shall be done without damaging the parent metal. Chipped edges shall be ground to a neat finish and sharp corners and hammered rough faces shall be rounded off. The edges and ends of all cut/sheared plates shall be plain/ground. Edge preparation for welding may be done by machine controlled flame cutting, with edges free from burrs should be clean and straight. The butting surfaces at all joints of girders shall be planed so as to butt in close contact throughout the finished joint. The edges shall be prepared, with an automatically controlled flame cutting torch, correctly to the shape, size and dimensions of the groove, prescribed in the design and fabrication drawings. In case of U-groove joints, the edges shall be prepared with an automatic false cutting torch in two phases, following a bevel out with a gouging pass or by machining. The welding surfaces shall be smooth, uniform and free from fins, tears, notches or any other defects, which may adversely affect welding, and shall be free of loose scale, slag, rust, grease, paint, moisture or any other foreign material. Assembly for Welding : Parts to be welded shall be properly assembled and held firmly in position by means of jigs and clamps prior to and during welding.

g. Welding Procedure: All welding procedures shall be submitted to the The Engineerfor approval, well before starting fabrication. The welding procedures shall be arranged by the Contractor to suit the details of the joints, as indicated in the drawings, and the position at which welding has to be carried out. Welding procedure shall cover the following:

   i. Type and size of electrodes
   ii. Current and (for automatic submerged arc welding) arc voltage
   iii. Length of run per electrode; or (for automatic welding) speed of travel
   iv. Number and arrangement of runs in multi run welds
   v. Position of welding
   vi. Preparation and set-up of parts
   vii. Welding sequence
   viii. Pre or post heating
   ix. Any other relevant information.
   x. Welding of 20 mm and more thick plates shall be done by beveling of edge to be welded.

The welding procedures shall be so arranged that distortion and shrinkage stresses are reduced to the minimum. Any weld found defective shall be removed, by using either chipping hammer or gouging torch, in such a manner that parent material is not injured in any way. Welding shall not be carried out when temperature is below 10 degrees Celsius or surface is wet or during periods of strong winds unless the work and the welder is adequately protected.

a. Welding: The welding shall conform to code, IS: 816 (1969) and IS: 9595 (1980) and other applicable codes and standards, unless otherwise specified. As much work as possible shall be welded in shops and the layout and sequence of operations shall be so arranged as to eliminate distortion and shrinkage stresses. All electrodes/ wires / flux shall be kept under dry conditions. Any electrode / wires /flux damaged by moisture shall not be used unless it is guaranteed by the manufacturer that, when it is properly dried, there will be no detrimental effect. Any electrode, which has part of its flux coating broken away or is otherwise damaged, shall be rejected. Any electrode /wires/ flux older than six (6) months from the date of manufacture shall not be used. Batch certificates for electrodes/ wires /flux shall be submitted by the Contractor.

b. Plate Construction : Automatic metal arc welding or sub merged arc welding shall be employed for fabrication of all members. Metal Inert gas welding may be done for short length where access to the location of the weld does not permit metal arc welding subject to approval of Engineer-in-charge.

c. Accuracy of Fit-Up : Parts to be fillet welded shall be brought into as close contact as practicable, and the gap due to faulty workmanship or incorrect fit-up shall not exceed 1.5mm. If greater separation occurs at any position, the size of fillet weld shall be increased at such positions by the amount of the gap.

d. Jigs and Manipulators : Jigs and manipulators shall be used, where practicable, and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators.

e. Ends of Butt Welded Joints : The ends of butt joints shall be welded so as to provide full throat thickness. This may be done by the use of extension pieces, cross-runs or other approved means.

f. Weld Face and Reinforcement of Butt welds : The weld face shall, at all places, be deposited projecting the surface of the parent metal. Where a flush surface is required, thesurplus metal shall be dressed off.

g. Testing of Butt Welds : Butt-welded joints are to be radio graphically tested (or Phased Array ultrasonic Testing) by the Contractor at his own cost in the presence of the The Engineer or his authorized representative, if desired by the The Engineer. If such tests indicate the joints to be defective, the cost of rectification of defective welds shall also be borne by the Contractor. The agency for testing of welds shall be specified for approval by engineer-in-charge.

h. Minimum Leg Length & Throat Thickness in Fillet Welds : The minimum leg length of a fillet weld as deposited shall be not less than the specified size as per codal provisions. In no case shall a concave weld be deposited,

unless specifically permitted. Where permitted, the leg length shall be increased above that specified length, so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat-faced weld of the specified leg length.

i. Dislodging : After making each run of welding, all slag shall be thoroughly removed and the surface cleaned.

j. Quality of Welds : The weld metal, as deposited (including tack welds), shall be free from- cracks, slag inclusions, porosity, cavities and other deposition faults. The weld metal shall be properly fused with the parent metal without under cutting or overlapping at the toes of the weld. The surface of the weld shall have a uniform consistent contour and regular appearance.

k. Weather Conditions : Welding shall not be done under weather conditions, which might adversely affect the efficiency of welding.

l. Qualification and Testing of Welders : The Contractor shall satisfy the The Engineerthat the welders are suitable for the work for which they will be employed, and shall produce evidence to the effect that welders, have satisfactorily completed appropriate tests, as described in IS:817 Part I (1992). The The Engineermay, at his own discretion, order periodic tests of the welders and/or of the welds produced by them. Such tests shallbe at the expense of the Contractor.

m. Supervision : The Contractor shall employ competent welding supervisors to ensure that the standard of workmanship and the quality of the materials comply with the requirements laid down in this document.

n. Machining of Butts and Bases : Splices and butt joints of compression members, depending on contact for stress transmission, shall be accurately machined over the whole section. In column bases, the ends of shafts together with the attached gussets, angles. channels etc., after bolting and/or welding together as the case may be, shall be accurately machined so that the parts connected butt over the entire surface of contact. Care shall be taken that connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 0.8mm.

Requirement of Welded Joints: Apart from the requirements of welding specified under the above sub clauses, sections above, the Contractor shall ensure the following requirements in the welded joints.

i) Strength-quality with parent metal.
ii) Absence of defects
iii) Corrosion resistance of the weld shall not be less than that of parent material in an aggressive environment.

Studs: Studs shall be used at interface of in-situ deck slab and plate girder to transfer the longitudinal shear. Unless otherwise specified the material used shall have characteristic yield strength of 385 MPA, minimum elongation of 18% and characteristic tensile strength of 495 MPA.

Welding of stud shear connectors: Unless otherwise provided the stud shear connectors shall be fusion welded to the plate girder using stud welding machine as per the manufacturer's instructions. No other type of welding shall be permitted. The stud and the surface to which studs are welded shall be free from scale, moisture, rust and other foreign material. The stud base shall not be painted, galvanized or cadmium plated prior to welding. Welding shall not be carried out when temperature is below 10 degrees Celsius or surface is wet or during periods of strong winds unless the work and the welder is adequately protected. The welds shall be visually free from cracks and shall be capable of developing at least the nominal ultimate strength of studs. The procedural trial for welding the stud shall be carried out when specified by the Engineer-in-charge.

Structural Steel Work - Quality Control & Testing Requirements

a. The scope of work of these specifications is to establish the norms for ensuring the required Quality Control through established testing norms of the welded structural steelwork by Engineer-in-charge.

b. The Contractor shall himself inspect all materials and shop work to satisfy the specified tolerance limits and Quality norms before the same are inspected by The Engineeror his authorized representative.

c. All materials, equipment and work of erection shall be subject to the inspection of the The Engineer who shall be provided with all facilities including labour and tools required at all reasonable times. Any work found defective is liable to be rejected.

d. No protective treatment shall be applied to the work until the appropriate inspection and testing has been carried out. The stage inspection shall be carried out for all operations so as to ensure the correctness of fabrication and good quality. Plate Girder dimensions and camber, if any, shall not be finally checked until all welding and heating operations are completed and the member has cooled to a uniform temperature.

e. Testing of material: All the materials shall be tested for mechanical and chemical properties as per various IS codes as may be applicable and shall conform to requirements specified. The cost of these tests shall be borne by the Contractor.

f. Rivets, bolts, nuts, washers, welding consumables, steel forging, casting and stainless steel shall be tested for mechanical and chemical properties as per the appropriate IS Code.

g. Rolling and cutting tolerance shall be as per relevant CPWD specifications

or Indian Standards. The thickness check measurements for the plate and rolled sections shall be taken at not less than 15 mm from edge. For plates thicker than 25mm, Check for laminations in plates shall be carried out by ultra- sonic testing or any other specified methods.

h. Steelwork shall be inspected for surface defects and exposed edge laminations during fabrication and blast cleaning. Significant edge laminations found shall be reported to the The Engineer for his decision. Chipping, grinding, machining or ultrasonic testing shall be used to determine depth of imperfection.

i. Bolted connections: Bolts and bolted connection joints with high strength bolts shall be inspected and tested according to IS: 4000. The alignment of plates at all bolted splice joints and welded butt joints shall be checked for compliance with codal requirements.

j. Welding and welding consumables: Welding procedure, welded connection and testing shall be in compliance with codal requirements. All facilities necessary for stage inspection during welding and on completion shall be provided to the The Engineer or his authorized representatives. Adequate means of identification either by identification mark or other record shall be provided to enable each weld to be traced to the welder(s) by whom it was carried out.

k. The Contractor shall through appropriate planning and continuous measurements in the workshop and the erection at site, ensure that the tolerance specified below are strictly adhered to. Tolerances in dimensions of components of fabricated structural steel work shall be specified on the drawings and shall be subject to the approval of the Engineer before fabrication.

l. Dimensional & Weight Tolerance: The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852, 808 etc. The acceptable limits of straightness for rolled or fabricated members as per IS: 7215.

m. The structural steel shall comply in all respects with the requirements of approved drawings and relevant codes and specifications and shall be procured from approved manufacturers only. It may be noted that quality of raw steel used for fabrication shall be essence of the contract & shall be strictly conforming to specified standard. Steel sections to be supplied by the manufacturers shall be tested as per codal provisions at the manufacturer's premises before dispatch. The Contractor on receipt of supply in his fabrication shop shall carry out necessary control tests including ultrasonic testing as per codal requirements and verify them with the list received from manufacturers. The rejected lot shall not be used and rejected lot shall be immediately removed from fabrication shop. Only steel passed in all tests

shall be used for fabrication.

n. The Contractor shall supply information in the technical package regarding source / manufacturers from where procurement of steel is proposed.

o. Fabricator agency shall have in house facilities for all testing of weld, as detailed in this tender document.

2.18. WATER PROOFING & INSULATION WORK :

For waterproofing of works below plinth level, complete envelope/box shall be ensured with Pre- applied HDPE waterproofing membrane and Post-applied Self- Adhesive Modified Bituminous Waterproofing membrane.

Basically in all the buildings all the RCC works below plinth level (foundations, columns, slabs, shear walls, retaining walls, beams, lift well etc.), RCC work in Terrace slab (Columns above it, if any), retaining walls (with or without weep holes), reservoir, U.G. Tanks, water retaining/carrying structures, sewage & water treatment plant etc.) shall be given waterproofing treatment by adding the cementitious integral crystalline admixture of make KRYTONE, PENETRON, XYPEX or equivalent @0.80% (minimum) to the weight of cement content per cubic meter of concrete) or higher as recommended by the manufacturer's specification in reinforced cement concrete at site of work. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e. by reducing permeability of concrete by more than 90%, compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure. The crystalline admixture shall be capable of self-healing of cracks up to a width of 0.50mm. The intension is to use integral cementitious crystalline admixture to all RCC works requiring the water proofing treatment. The product performance shall carry guarantee for 10 years against any leakage.

Pre-applied waterproofing membrane of 1.2 mm thick flexible sheets of make Pidilite, Grace, BASF or equivalent, consisting of HDPE carrier sheet coated with a pressure-sensitive adhesive and trafficable, weather and dirt resistant non-absorbent coating shall be used for waterproofing treatment below horizontal surface of foundations or underground structures exposed to soil (e.g. grade slab, raft, footing, lift pit base, UG tank, etc.). Sheet shall be durable and robust, manufactured using only virgin HDPE. The membrane shall form a continuous and permanent adhesive bond to poured concrete to prevent lateral water migration at the interface of the membrane and structural concrete. Continuity between adjacent sheets shall be assured using only adhesive to adhesive sealing, using either manufactured Zip Lap™ at side laps, or multiple adhesive layer tape at end laps or cut edges. Pre- applied membranes shall be smooth faced to avoid clogging or contamination and easy to clean prior to concreting to ensure intimate bonding to concrete. The membrane shall be capable of UV exposure without additional protection for a maximum of 45 days prior to concrete pouring. Third party test report from NABL accredited approved laboratory along with MTC of product should be submitted. Test report should not be older than 5 years. All

detailing components of the system has to be compatible with the proposed waterproofing membrane and has to be manufactured and supplied by the manufacturer of waterproofing membrane. The Membrane shall confirm to following properties (minimum)- i) Pass for Lateral water migration resistance in both directions at 70 m (7 bar) of hydrostatic head pressure as per ASTM D 5385 modified. ii) Peel Strength to Poured-in-Place

Concrete after 7 days of water immersion should be >880N/m as per ASTM D 903.

Lap peel adhesion of 1408 N/m at 22°C as per ASTM D1876. iv) Peel Strength to Poured-in-Place Concrete of >880N/m – ASTM D 903. v) Elongation of at least 400 % as per ASTM D412. vi) Tensile strength of more than 27.6 MPA as ASTM D412. vii) Puncture Resistance of more than 890 N as per ASTM E154. All systems to be installed as per manufacturer's specification and executed by manufacturer's certified applicators (in house team) after successful mock-up at site etc.

Post-applied Self-Adhesive Modified Bituminous Waterproofing membrane of 1.5 mm thickness of make Pidilite, Grace, BASF or equivalent shall be used for waterproofing treatment on vertical sides of foundation system or underground structures exposed to soil (e.g. lift pit walls, retaining walls without weep holes, walls in continuation with the foundations, UG tank etc.). The water proofing treatment shall be as per manufacturer's specification and applications shall be by the manufacturer's certified applicators. The system shall be a self-adhesive, cold applied flexible water proofing membrane comprising of self-adhesive rubberized asphalt with cross laminated HDPE film with a unique solar reflective film on top surface. The membrane shall have pre-marked overlaps of 50mm and shall be applied on the uniform concrete surface and shall have expanded polystyrene protection including a load of bitumen solution primer on RCC surface. The membrane have following typical property values: i) Minimum thickness of 1.5 mm with HDPE thickness of minimum 0.2 mm as per ASTM D3767. ii) Hydrostatic Head Resistance of more than 70 m, as per ASTM D5385 test carried out on an overlap crossing a post formed crack. iii) Water Vapour Transmission Rate: 0.06 g/m2/day as per ASTM E96. iv)) Elongation of at least 200 % as per ASTM D412. vi) Tensile strength of more than 482 psi as ASTM D412. vii) Puncture Resistance of more than 280 N as per ASTM E154.

Waterproofing cum insulation on terrace slabs shall be with an average 90 mm thick spray applied CFC & HCFC free polyurethane foam of Pidilite, BASF or equivalent, conforming to CPWD GHAR, IGBC, & GRIHA standards. The material shall have a core density of 50-60 kg /m3 (as per ASTM 1622), thermal conductivity of 0.023 W/m.k at 25°C mean temperature (as per ASTM C518/91), U-value of 0.28 W/m^2K as per ECBC standards for cold climate type, tensile strength of >400 kPa (as per ASTM D 1623/78), compressive strength >300 kPa (as per ASTM D 1621), closed cell content having apparent VOI of 96-98% (as per ASTM D 2856) and fire resistance property confirming to Class B2 as per DIN 4102. Before applying polyurethane foam, cracks shall be repaired by cutting V groove in 25x25 mm size and filling the same with polymer modified mortar(1:3 Cement Mortar having polymer @10% by weight of cement). Base coat of highly elastomeric two

component polyurethane based waterproofing coating (elongation of 600% and tensile strength of 6MPA) shall be applied at 1.5 kg/Sqm at the corners above the mother slab for a length of 150mm horizontally and 150mm vertically. Top of the polyurethane foam shall be applied with highly elastomeric two component polyurethane based waterproofing coating (elongation of 600%, tensile strength of 6MPA as per ASTM D 412) at 1.5 kg/Sqm. 150 gms Geo-textile (non-woven polyester) over the entire membrane maintaining proper overlaps shall be applied. A filler board of 10mm thickness for construction joints shall be placed vertically to form a rectangular bay not exceed 12sqm. The treatment should be followed by protective layer of average 75 mm thick concrete screed (grade M-15) including control joints of 3M X 4M size and making angle fillet of 50mmX50mm using concrete at the corners. Exposed filler boards shall be cut by mechanical means and groove shall be filled with Poly-sulphide Sealant. The width of sealant fill shall not exceed 10mm. All systems shall be installed by authorized applicators (in house team of manufacturer) as per manufacturer's recommendations and includes all lead and lift for all materials and labor.

Water proofing treatment to vertical and horizontal surfaces in all internal wet areas of building (e.g. Toilets/Kitchens/AHU/balconies etc.) shall consist application of water based, anti root, low VOC, single component, pure PU Polyurethane elastomer water proofing membrane of make PIDILITE, GRACE, BASF or equivalent with 1.5 mm DFT, having solid % value > 90, tensile strength > 2 MPA, Elongation > 550%, shore 'A' hardness 60 ± 5 with a 150 gms polyester geotextile membrane. The system includes base preparation of cleaning, brushing and removal of flaky materials, grouting the porous area with cementitious grout, proper covering between slab and wall junctions and priming the surface as per manufacturer's specification. The coating shall be continued to the entire horizontal area and should be terminated at 300mm above the floor finish level complete as per manufacturer's specification. The treated horizontal surface shall be provided 40 mm (minimum) concrete screed (Grade M-15). The Vertical surface shall be provided with 15 mm thick Protective mortar of (1 Cement: 4 Coarse Sand) mixed with integral waterproofing compound of approved make as per manufacturer's specifications. All systems shall be installed by authorized applicators (In house team of manufacturer) as per manufacturer's recommendations and includes all lead and lift for all materials and labor.

Water proofing treatment to vertical and horizontal surfaces in all internal areas of building (ESS STP) shall consist application of integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI- 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-

charge. The product performance shall carry guarantee for 10 years against any leakage.

2.19. ROAD WORK:

All roads will be Cement concrete Road & Paver Block pavement at car parking area roads (as per drawings), as per MORTH specifications (fifth edition), laid over sub grade duly prepared with power roller of required thickness as per design. Irrespective of whether shown in drawings or mentioned in tender document, all the drainage, signages (Informative, Mandatory, Regulatory etc.) other works associated with road works shall be provided as per relevant standards and specification. MORTH Specifications for Road and bridge work (Fifth Revision). The work shall be carried out using MORTH Specifications for Road and bridge work (Fifth Revision). The thickness of layers shall be followed as per tender drawings and get approval from The Engineer

As far as possible cross drainage should be taken under the road and at right angle to it.

Cement Concrete Road: Consisting the layer of C.C pavement M25 grade, Dry lean Concrete-(DLC) 125micron membarne Granular sub base (GSB) and sub grade. As per IRC code recommendation cement concrete road manual.

Sub grade: It shall be prepared and consolidated with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5 cm depth, dressing to camber and consolidating with road roller including making well the undulations etc. and re-rolling the sub grade and disposal of surplus earth.

Granular Sub-Base: Construction of granular sub-base shall be, by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge. With material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30.

Dry lean cement concrete: Sub base over a prepared sub-grade with coarse and fine aggregate conforming to IS:383, the size of coarse aggregate not exceeding 25 mm, aggregate cement ratio not to exceed 15:1, aggregate gradation after blending to be as per specifications, cement content not to be less than 150 Kg/cum, optimum moisture content to be determined during trial length construction, concrete strength not to be less than 10 Mpa at 7 days, mixed in a batching plant, transported to site, for all leads & lifts, laid with a mechanical paver, compacting with 8-10 tonne vibratory roller, finishing and curing etc. complete as per direction of Engineer in- charge.

Cement Concrete Pavement: Design mix cement concrete of M-30 grade shall be laid as per drawings, in roads/ taxi tracks/ runways, using coarse sand and graded stone aggregate of 40 mm nominal size in appropriate proportions as per approved & specified design criteria,

providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, leveling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction/ expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants.

80mm Thick Paver Block Pavement:

Consisting the layer of 80mm thick paver block M30 grade with sand bed 50mm thick, Wet Mix Macadam, Granular sub base (GSB) and sub grade. As per IRC code recommendation, Interlocking paver block manual.

80mm thick Factory made chamfered edge Cement Concrete paver blocks in drive ways or light traffic parking etc, of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand. complete all as per direction of Engineer-in-Charge.

Wet Mix Macadam: It shall consists providing, laying, spreading and compacting graded stone aggregate (size range 53 mm to 0.075 mm) to wet mix macadam (WMM) specification including premixing the material with water at OMC in mechanical mix plant, carriage of mixed material by tipper to site, for all leads & lifts, laying in uniform layers with mechanical paver finisher in sub- base / base course on well prepared surface and compacting with vibratory roller of 8 to 10 tonne capacity to achieve the desired density.

Granular Sub-Base: Construction of granular sub-base shall be, by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge. With material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30.

60mm Factory made chamfered edge Cement Concrete paver blocks in footpath, parks, lawns, etc, of required strength, thickness & size/ shape, made by table vibratory method using PU mould, laid in required colour & pattern over 50mm thick compacted bed of sand, compacting and proper embedding/laying of inter locking paver blocks into the sand bedding layer through vibratory compaction by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern, finishing and sweeping extra sand. complete all as per direction of Engineer-in-Charge.

Factory made kerb stone: It shall be of M-25 grade cement (made by using ingredients from

C & D waste) shall be provided at or near ground level in position to the required line, level and curvature jointed with cement mortar 1:3 (1cement: 3 coarse sand) as per drawings including making joints with or without grooves (thickness of joints except at Sharpe curve shall not to more than 5mm) including making drainage opening wherever required complete etc.

Cement Concrete (M30 grade) tactile tile: Such as directional, warning or hazardous (for vision impaired persons as per standards) of size 300x300x60 mm{60 mm base + (5mm ± 0.5mm) thick raised portion} having water absorption ⩽ 6% and conforming to IS: 13801, of approved make in all color's (preferably yellow) and shades for footpath should be laid on 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. (The thickness of wearing layer should not be less than 8mm) and as per harmonized guidelines and space standards for barrier free built environments for persons with disability and elderly persons issued by Ministry of Urban Development, Govt. of India.

Coloured, preferably yellow PU - Tactile Studs Warning/Positional) with 1 stem having stem dia of 6.0 mm & stem length between 20 - 25 mm, as ground surface indicators shall be provided for the visually impaired persons, on the pedestrian pathway as per manufacturers design / specification and as per harmonized guidelines.

Coloured, preferably yellow PU - Tactile strips (Guiding) with 3 stems having stem dia of 6.0 mm & stem length between 20 - 25 mm, as ground surface indicators shall be provided for the visually im-paired persons on the pedestrian pathway as per manufacturers design / specification and as per harmonized guidelines.

Gang saw cut 30 mm thick or of thickness specified in drawings, mirror/Flamed polished pre moulded and pre polished machine cut granite stone of required size and shape of approved shade, colour and texture in footpath, flooring in road side plazas and similar locations as per landscape drawings, shall be laid over 20mm thick base of cement mortar 1:4 (1 cement: 4 coarse sand) including grouting the joints with white cement mixed with matching pigment, epoxy touch ups etc.

RCC Perforated Drain Covers: Factory made precast RCC perforated or non- perforated drain covers having concrete of strength not less than M-25, of required sizes for road side drains/underground utility shaft or duct, shall be provided. These should be properly reinforced to carry the desired load.

Drain Cell shall be of 20mm thickness (Weight Over 2Kg/sq. mt) consisting of High strength Polypropylene module having size of 500mm x 250mm and 20mm height with interlocking tabs. The Drain Cell to have compressive strength of over 120 tons/sqmt and weight of more than 2kg/sqmt. Drain Cell to be laid by interlocking individual modules their by covering the entire area. Drain Cell to be covered with Geo-textile 150 GSM with 200mm overlap before laying planting soil. Laying to be done as per manufacturer instructions.

Chain Link Fencing: G.I. chain link fabric fencing of required width in mesh size 50x50 mm including strengthening with 2 mm dia wire or nuts, bolts and washers as required complete as per the direction of Engineer-in-charge.

Made of G.I. wire of dia. 4 mm, PVC coated to achieve outer dia not less than 5 mm in required colour and shade. The length, height and position of foundation shall be followed as per in tender drawing and Engineers direction and in-charge

Road Surface marking: it shall be done with two or more coats to give uniform finish with ready mixed road marking paint conforming to IS: 164, on white/yellow shade, including cleaning the surface of all dirt, scales, oil, grease and foreign material etc.

Retro Reflective Signage Boards: It shall consist manufacturing, supplying and fixing made up of 2 mm thick aluminum sheet, face to be fully covered with high intensity and encapsulated lens type heat activated retro reflective sheeting conforming to type - III of ASTM-D- 4956-01 as approved by Engineer-in-charge, letters, borders etc. as per IRC : 67-2001 in silver white with blue colour back ground and with high intensity grade, pasted on substrate by pressure sensitive adhesive backing which shall be activated by applying pressure conforming to class II of ASTM-D-4956-01 and fixing the same to the plate of structural frame work by means of suitable sized aluminum alloys, rivets or bolts & nuts @ 300 mm centre to centre all along the periphery as well as in two vertical rows along with theft resistant measures, including the cost of painting with two or more coats of epoxy paint in grey colour on the back side of aluminum sheet including appropriate priming coat. The process includes rounding off the corners, lowering down the structural frame work from the gantry, fixing and erecting the same in position all complete as per drawings, specification.

2.20. SIGNAGES:

Signages inside/outside building shall be in English & Assamese language as per NBC 2016 guidelines and of approved design and make with LED backlit. Each rooms shall be provided with Name Boards, Numbering of rooms, Signages etc. The Contractor shall prepare the detailed shop drawing in compliance to the NBC 2016 guidelines and disable friendly building norms of MoHUA.

Name Boards for buildings shall be of approved design and make (like suitable gauge, 2 feet height SS 304 lettering) with LED backlit.

Signage works include providing and fixing Building Entrance signage / Tactile Layout / Emergency Evacuation Layout on the wall or with any other required structure, with provision of multilingual text integral with 4mm thick blue Acrylic base plate with min 0.5 mm Aluminium sheet at the back with Upper Case San Serif words made of white acrylic non glare cut out letters of height 15mm, raised above base plate by not less than 0.8mm and the equivalent word/s written in English & Assamese / any language as required with same specifications with Grade 1 Braille to be integral with the sign face and should be raised 0.5mm above Acrylic base plate. Each signboard to be fixed strictly as per the Harmonized

Guidelines & Space Standards for Barrier Free Built Environment for persons with Disability, issued By MOUD, Govt. of India, and as per approved drawings and complete as per the directions of Engineer - In - Charge. Size of the Signboards shall be proportional to the layout plan of the particular building, Min Size of the above signboards shall not be less than 1200mm X 750 mm.

Identification signages (e.g. Room Names / Rooms Number / Toilet facility / Drinking Water / Staircase / Entry / Exit / Lift etc.) of the size 150 mm X 230 mm or 200 X 200 mm).

Floor Directories (Signboard Placed near the Lift / Staircase / Entry to the particular Floor indicating the facilities on that floor which are normally also called as Directional Signages) shall be of minimum size not be less that 450 mm X 450 mm.

Emergency Exit Sign Boards (Generally used Text as "In Case of Emergency, Do Not Use The Lift", "Emergency Exit" etc.)

2.21. HORTICULTURE & LANDSCAPE WORK:

GENERAL: Contractor to furnish all materials, labor and related terms necessary to complete the work indicated on drawing and specified here in. The quantities given herein for various plants/trees/shrubs/grass etc. are tentative. However, the Contractor shall provide the actual quantities as per the scope of work and requirement at site.

Materials:

a) Plant materials:

(i) Plant materials shall be well formed and shaped true to type, and free from disease, insects and defects such as knots, windburn, injuries, abrasion or disfigurement.

(ii) All plant materials shall be healthy, sound, and vigorous, free from plant disease, insect pests or their eggs, and shall have healthy, well-developed root systems.

(iii) All plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants supplied shall conform to the names listed on both the plan and the plant list. No plant material will be accepted if branches are damaged or broken. All material must be protected from the sun and weather until planted.

(iv) Any nursery stock shall have been inspected and approved by the Engineer-in-Charge.

(v) All plants shall conform to the requirements specified in the plant list, except that plants larger than specified may be used if approved, but use of such plants shall not increase the contract price. If the use of the larger plant is approved, the spread of roots or ball of earth shall be

increased in proportion to the size of the plant.

(vi) Plants shall be delivered with legible identification labels.

b) Topsoil: Topsoil or good earth shall be a friable loam, typical of cultivated topsoil of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, earth clods, sticks, roots or other objectionable extraneous matter or debris. It shall contain no toxic material. No topsoil shall be delivered in a muddy condition. Good earth shall have PH range 6.5 to 7.5

c) Manure (as locally available): Dry farm yard manure shall be used. It shall be free from extraneous matter, harmful bacteria insects or chemicals.

d) Root System: The root system shall be conducive to successful transplantation. Where necessary, the root-ball shall be preserved by support with hessian or other suitable material. On soils where retention of a good ball is not possible, the roots should be suitably protected in some other way which should not cause any damage to roots.

e) Condition: Trees and shrubs shall be substantially free from pests and diseases, and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions, such as prolonged exposure to drying winds or subjection to water-logging, between lifting and delivery.

f) Supply and substitution: Upon submission of evidence that certain materials including plant materials are not available, the Contractor shall be permitted to substitute other material and plants, with an equitable adjustment of price. All substitutions shall be of the nearest equivalent species and variety to the original specified and shall be subject to the approval of the engineer-in- charge.

g) Packaging: Packaging shall be adequate for the protection of the plants and such as to avoid heating or drying out.

h) Marking: Each specimen of tree and shrub, or each bundle, shall be legibly labelled with the name of the supplier and the date of dispatch from the nursery, unless otherwise agreed.

Trees, Ornamental Plants & Palms Planting:

a) Trees should be supplied with adequate protection as per drawing and as approved by the engineer in-charge. After delivery, if planting is not to be carried out immediately, balled plants should be placed cheek to cheek and the ball covered with sand to prevent drying out. Bare-rooted plants can be heeled in by placing the roots in a prepared trench and covering them with earth which should be watered into avoid airpockets round the roots.

b) Digging of Pits: Tree pits shall be dug a minimum of three weeks prior to back filling. The pit sizes shall be as specified further herein. It shall be replaced with soil mixture as specified further herein. While digging the pits, the top soil up to a depth of 30 cm may be kept aside, if found good (depending upon site conditions) and mixed with the rest of the soil. If the soil is bad below, it shall be replaced with the soil mixture as specified further herein. The bottom of the pit shall be forked to break up the sub-soil.

c) Back filling: If the excavated soil is normal, it shall be mixed with manure. River sand shall be added to the soil if it is heavy. However, if the soil is bad, the pit shall be refilled with imported good garden soil mixed with manure 2:1 by volume (2 parts of stacked volume of earth after 20% reduction: 1 part of stacked volume of manure after 8% reduction). The soil back filled has to be watered through and gently pressed down a day previous to planting to make sure that it may not further settle down after planting. The rest 100mm shall be filled with manure. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all around for watering.

d) Planting: No tree pits shall be dug until final tree positions have been pegged out for approval. Care shall be taken that the plant sapling when planted is not buried deeper than in the nursery, or in the pot. Planting should not be carried out in water logged soil. Plant trees at the original soil depth; the soil marks on the stem is an indication of this and it should be maintained on the finished level, allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damaged roots should be cut back to sound growth. The bottom of the planting pit should be covered with 50mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; and small mound in the centre of the pits on which the roots are placed will aid an even spread. Soil should be placed around the roots, gently shaking the tree to allow the soil particles to sift into the root system to ensure close contact with all roots and to prevent air pockets. Backfill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid to avoid damaging the roots, as follows:

e) o Chlorpyrifo semulsifiable concentrate 0.2% shall be applied on walls of pit, and initially pit shall be filled to 200 depth with earth mixed Chlorpyrifos emulsifiable concentrate 0.2%. The balance earth shall be filled in with manure in proportion as specified further herein. Chlorpyrifos emulsifiable concentrate 0.2% shall be applied every 15 days.

f) Staking: Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

g) Methods: The main methods of staking shall be:

   i. A single vertical stake, 900mm longer than the clear stem of the tree, driven 600mmto 900mm into the soil.

   ii. Two stakes as above driven firmly on either side of the tree with a cross-bar to which the stem is attached. Suitable for bare-rooted or balled material.

   iii. A single stake driven in at an angle at 450 and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare-rooted or balled material.

   iv. For plant material 3m to 4.50 m high with a single stem a three-wire adjustable guy system may be used in exposed situations.

   v. The end of stake should be pointed and the lower lm to 1.20m should be coated with a non-injurious wood preservative allowing at least 150mm above ground level.

h) Tying: Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion must be avoided by using a buffer, rubber or hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground Level; normally two ties should be used for tree. These be adjusted or replaced to allow for growth.

i) Watering: The Contractor should allow for the adequate watering in of all newly planted trees and shrubs immediately after planting and he shall during the growing seasons, keep the plant material well-watered.

j) Fertilizing: Fertilizing shall be carried out by application in rotation of every 15 days from the beginning of the monsoon till the end of winter: - sludge of organic well-rotted dry farmyard manure or vermicomposting or approved organic manure as per directions of engineer-in-charge.

Shrubs, Ground Covers, Creepers Planting In Planters And Beds

a) All areas to be planted with shrubs shall be excavated, trenched to a depth of 600 mm, refilling it with finely mixed good black garden soil and excavated earth (after breaking the clods and mixing with sludge in the ratio as specified further herein. Backfill soil should be firmed as filling proceeds, layer by layer, care being taken to avoid to avoid damaging the roots, as follows:

b) o Chlorpyrifos emulsifiable concentrate 0.2% shall be applied on walls of pit. The balance earth shall be filled in a mixture with manure in proportion as specified further herein. Chlorpyrifos emulsifiable concentrate 0.2% concentration shall be applied every 15 days.

c) Tall shrubs may need staking, which shall be provided if approved by the engineer-in- charge depending upon the conditions of individual plant specimen.

d) For planting shrubs and ground cover shrubs in planters, good earth shall be mixed with sludge in the proportion as above and filled in planters.

e) Positions of shrubs to be planted should be marked out in accordance with the planting plan. When shrubs are set out, precautions should be taken to prevent roots drying. Planting holes (of sizes as specified further herein) should be excavated for longer shrubs. Polythene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level, after settlement, will be at the original soil mark on the stem of the shrub. The hole should be backfilled to half pots depth and firmed by treading. The remainder of the soil can then be returned and again firmed by treading.

f) Grass areas:

   a. Mixing earth and manure in proportion 8:1 and spreading to a thickness of 200mm.

   b. Fine dressing the ground (to levels specified).

   c. Grassing with selection No. 1 grass including watering and maintenance of the lawn for 60 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed.

   d. In rows 5 cm apart in both directions

   e. Flooding the ground with water including making kyries and dismantling the same.

Ground Cover And Herbal Plants

a) Pit Preparation: Preparing planting beds for ground covers planting by excavating and refilling the same with sweet earth mixed with manure 8:1 by volume (8 parts of stacked volume of earth after 20 % reduction: 1 part of stacked volume of manure after 8 % reduction), flooding with water, dressing including removal of rubbish and surplus earth if any with all leads and lifts; excluding cost of earth and manure. Unless otherwise specified, pit size shall be 0.15m x0.15m x 0.30 m.

b) Supply and plantation: Planting best quality ground covers of species and height as specified. All ground covers to be planted should be best quality pot-grown healthy ground covers inclusive of preparation and cultivation of ground cover beds as specified. All plantsto be approved before planting.

Creepers:

a) Pit Preparation: Preparing planting beds for creepers planting by excavating and refilling the same with sweet earth mixed with manure 8:1 by volume (8 parts of stacked volume of earth after 20 % reduction: 1 part of stacked volume of manure after 8 % reduction), flooding with water, dressing including removal of rubbish and surplus earth if any with all leads and lifts; excluding cost of earth and manure. Unless otherwise specified, the pit size shall be 0.6m x0.6m x 0.6m.

b) Supply and plantation: Planting best quality creepers of species and height as specified. All ground covers to be planted should be best quality pot-grown healthy ground covers inclusive of preparation and cultivation of creeper beds as specified. All plants to be approved before planting.

The Contractor shall supply the sweet earth, cow dung manure, vermi compost manure, coco peats etc. as per requirement specified for horticulture works. Approximate volume would be around 2000 Cum.

Mounds:

Contractor shall prepare mounds of various size and shape by available excavated / supplied earth in layers not exceeding 20 cm in depth, breaking clods, watering of each layer, dressing etc., lead upto 50 meter and lift upto 1.5 m complete as per direction of engineer-in-charge. Geocell is a three dimensional geocellular confinement system designed for steep slopes, river banks, ditches, spillways, and other exposed areas that are often prone to damage caused by erosion due to wind or water. Geocell system can help to prevent erosion by confining soils and aggregates within the cell structure. Varying degrees of protection can be afforded by selecting alternative in-fill materials. Seeded topsoil provides protection for less exposed areas. Protection may be increased by introducing vegetation such as small shrubs

Miscellaneous:

Anti- termite treatment: Providing and injecting chemical emulsion for post construction anti termite treatment along the external wall up to depth of 300mm as per CPWD specifications.

Anti-Termite Chemical Treatment: Post Constructional anti-termite treatment shall be with Chloropyriphos/ lindane emulsifiable concentrate 20% with 1% concentration as per CPWD specification.

Damp Proof Course: Damp proof course shall be with 40 mm thick cement concrete 1:2:4 (1cement:2 coarse sand :4 graded stone aggregate 12.5mm nominal size) mixed with water proofing compound painted at top with a coat of residual petroleum bitumen of grade VG-10 of approved quality at 1.7 kg/sqm.

Plinth Protection: Plinth Protection as per drawing (minimum 1000mm wide) shall be with 50mm thick cement concrete 1:3:6 (1cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) over 75mm of brick ballast 40 mm nominal size with brick edging.

Barricading: 6 metre high temporary barricading at site as per drawing/ direction of The Engineerwhich includes writing and painting, arrangement for traffic diversion such as traffic signals during construction at site for day and night, glow lamps, reflective signs, marking, flags, caution tape as directed by the Engineer-in- Charge. The barricading provided shall be retained in position at site continuously. Rate include its maintenance for damages, painting, all incidentals, labour materials, equipments and works required to execute the job. The barricading shall not be removed without prior approval of Engineer-in-Charge.

TEMPORARY WORKS

i. All costs and charges on temporary works will be borne by the contractor unless specifically listed in BOQ.

ii. All the approach roads, ramps, platforms, stacking yards required for the construction of the work shall be formed by the contractor at his own cost and no payment will be made by the Engineer.

iii. All royalty, Taxes & Duties on materials procured and Government quarries shall be borne by the contractor.

iv. No plot rent shall be charged for materials stacked on Government land during the course of construction provided that all such materials are removed within one month after the work is completed.

v. General set-up

Construction and maintenance of temporary facilities shall comprise but is not limited to site office, store, plant & machinery yard, shuttering & reinforcement yards, site utility, security, temporary access roads, other miscellaneous expenses etc. to the complete satisfaction of the Engineer.

- Contractor Site office.
- First Aid room
- QA/QC aid room
- General store
- Chemicals / Hazardous material store
- Plant & Machinery yard
- Shuttering yard
- Reinforcement Yard
- Temporary Access Road
- Temporary Fencing around GC facility
- Site Utility
- Site security
- Safety Stewards
- Signal Men
- Traffic Marshalls

The contractor shall at his cost construct and maintain temporary roads/ access ways to suit site requirements and avoid dusty atmosphere. For the use of temporary roads constructed by the contractor and used by other agencies the contractor may share the cost of construction and maintenance of such roads with other contractors/ agencies as determined by the

Engineer.

In respect of certain portions of temporary roads/access already provided by client, the contractor shall be allowed free passage but regular maintenance of the same in motorable condition at all times shall be the contractor's responsibility and allow passage for other contractors/agencies authorised by Employer's Representative.

DEWATERING

All charges and cost of dewatering by bailing and/or by pumping and/or by diversion will be borne by the contractor at no extra cost. The surface flow of water should be diverted from the work spot by forming temporary bunds at the contractor's own cost.

TEMPORARY LIGHTING

The contractor shall make his own arrangement in respect of the provision of adequate lighting at all places where his workmen are engaged at all hours, materials are stored etc. for carrying out the work in a proper safe and satisfactory manner.

PARKING FACILITIES

The contractor shall at his cost provide adequate covered parking facilities for the staff of contractor, Engineer and owner after discussion with Employer's Representative.

WORK SHEDS, STORAGE OF MATERIALS AND EQUIPMENT AT SITE

i. The contractor shall, at his own cost, provide adequate storage sheds and yards at site, at locations approved by the Employer's Representative, for all materials and equipment that are to be incorporated in the works. In addition to being water-tight and weatherproof, the storage facilities shall be of such a manner that all the materials and equipment are adequately protected in every way from any deterioration or contamination or damage whatsoever and to the complete satisfaction of the Employer's Representative. Should any of the materials or equipment deteriorate or be contaminated or damaged in any way due to improper storage or for any other reason, such materials and equipment shall not be incorporated in the works and shall be removed forthwith from the site. The replacement of all such materials and equipment shall be entirely at the cost and expense of the contractor. The proper record shall be kept and approved by employer.

ii. Should delays be caused on account of removal and replacement of any materials or equipment or on account of any lack of security, the contractor shall not be entitled to any extension of time, and shall be liable to penalties as per relevant clause.

iii. Wherever applicable the storage of materials shall be in accordance with the relevant Indian Standard specifications.

iv. Cement storage capacity of contractor shall be adequate to store suitable for at least 30 day's work quantity of cement, keeping in view the schedule of work.

v. Coarse and fine aggregates shall be stored over hard concrete base or paved brick platforms. Reinforcement bars shall be stored diameter-wise over raised sleepers and protected from rain and water logging in suitable manner as approved by the Employer's Representative.

vi. Physical 3D model for the entire layout of the project showing all the building features shall be displayed at site by the contractor at the contractor's own expense.

SCAFFOLDING, STAGING, GUARD RAILS, BARRICADES

The contractor shall at his cost provide scaffolding, staging, guard rails, barricades and safety barriers around, all excavations, openings and at all edges temporary stairs and other temporary measures required during construction. Barricading of periphery of the site using GI sheets supported on MS poles as approved by the Employer's Representative, to a height of 6m, from the average ground level. The supports for the scaffolding, staging guard rails, barricades and safety barriers and temporary stairs shall be strong, adequate for the particular situations, tied together with horizontal pieces and braced properly. The temporary access to the various parts of the building under construction shall be rigid and strong enough to avoid any chance of mishaps. The entire scaffolding arrangement together with the staging, guard rails, barricades and safety barriers and temporary stairs shall be to the approval of the Employer's Representative which approval shall not relieve the contractor of any of his responsibilities, obligations and liabilities for safety and for timely completion of the works.

NOTICES, FEES, BYE LAWS, REGULATIONS, LICENCES AND PERMITS

i. The contractor shall comply with all government acts including the bye-laws or regulations of local authorities relating to the works in so far as labour, construction, fabrication and installation activities including safe disposal of debris and surplus soil etc outside the site, are concerned and he shall obtain from the local authorities all permissions and approvals required for labour deployment and the plying of trucks, safe disposal of debris and surplus soil, use of construction machinery, etc. and also for construction of temporary offices, labour camps, stores and other temporary structures in connection with his work and the contractor shall give all notices and pay all fees and charges that are and that may be demanded by law there under. In his rates for the various items of work, the contractor shall allow for such compliance and work and for the giving of all such notices and shall include for the payment of all such fees and charges. The contractor shall indemnify the owner against all claims in this regard.

ii. All licenses and permits for the materials under government control and those required to be obtained by the contractor for the execution of his work, shall be directly obtained by the contractor. The contractor shall include in his rates for all transportation charges, disposal charges and for the other expenses that

may be incurred in this connection and he shall indemnify the Employer against all claims in this regard.

LABOUR REGULATIONS

i. The contractor shall be wholly and solely responsible for full compliance with the provisions under all labour laws and or regulations in force such as payment of Wages Act, Employees Liability Act, workmen's Compensation, Industrial Disputes, Maternity Benefit Act, Contract Labour (Regulation and Abolition) Act and the Factories Act or any modifications thereof or any other law relating thereto and rules thereunder introduced from time to time. The contractor shall assume liability and shall indemnify the Employer from every expense, liability or payment by reason of the application of any labour law, act, rules or regulations existing or to be introduced at a future date during the currency of the contract. Insurance cover towards the above shall be affected by the contractor as necessary.

ii. The contractor shall not employ any labour less than 18 years of age on the job. If female labour is engaged the contractor shall make necessary provisions at his own expense for the safeguarding and caring of small children and keeping them clear off the site operations. No children shall be permitted on the construction site. Employer's Representative shall have the authority to effect penalties to this effect as deemed necessary.

. HEALTH & SAFETY

i. In respect of all Contractor personnel/ Employer's Representatives, directly or indirectly employed on the works for the performance and execution of the contractor's work under the contract, the contractor shall at his own expense arrange for all the safety provisions as listed in (i) Health & Safety Manual part of the contract documents (ii) Bureau of Indian Standards (iii) The Electricity Act (iv) Rules and Regulations and orders made there under and such other acts as applicable. The contractor shall be wholly and solely responsible for overall HSE (Health, Safety and Environment) issues.

ii. Precautions as stated in the safety clause are the minimum necessary and shall not preclude the contractor taking additional safety precautions as may be warranted for the particular type of work or situations. Also mere observance of these precautions shall not absolve the contractor of his liability in case of loss or damage to property or injury to any person including the contractor's labour, the owner, architect's and Engineer's representatives or any member of the public or resulting in the death of any of these.

iii. Protective gear such as safety helmets, safety boots, safety belts/ harness and safety nets, etc. shall be provided by the contractor at his own cost to all his manpower at site. The contractor shall impose such requirements on all sub-contractors also. It shall be the responsibility of the contractor to ensure that such protective gear is worn at all times by all personnel working within the site premises.

iv. The contractors shall take all precautions and preventive measures against fire hazards at the site, in his stores, workshop, labour camp, etc. and shall assume full responsibility for the same.

v. A first aid room with following necessary medical facilities to be provided: A sink with hot and cold running water, drinking water, clinical thermometer, couch with pillow and blankets in hygienic condition, impermeable work surfaces and clean garments for use by first-aiders, first aid kit, tetanus injection.

vi. The entire site shall be tobacco free zone. Usage of tobacco shall not be allowed within the site.

vii. The Employer's Representatives shall have the right to stop work or impose fines to any person violating any of the clauses mentioned above.

viii. In case the contractor fails to make arrangements and provide necessary facilities as aforesaid, the owner shall be entitled to do so and recover the costs thereof from the contractor. The decision of the Employer's Representative in this regard shall be final and binding on the contractor.

ix. In case of any incident of fire, Contractor shall intimate fire department immediately and provide all necessary support to their personnel for safe evacuation. The Contractor shall demarcate a safe assembly area for such incidents and shall conduct periodic fire safety drill in the site at his own expense. Damages if any, shall be responsibility of the Contractor who shall keep the Employer indemnified to this effect at all times

INSURANCE/ INDEMNITY

i. The contractor shall insure the works and personnel against accidents, fire, theft, natural hazards, arson and riot to keep the Employer indemnified at all times. A copy of the valid certificate(s) shall be submitted to the Employer's Representative for reference.

ii. In the event of an extension of the time for completion, the contractor shall, on his own account, ensure an extension of the time for the Demand/ Bank Guarantee which shall be made before the expiration date established in the guarantee.

CO-ORDINATION OF WORK

i. Contractor shall be responsible for co-ordination and liaisoning with the concerned line departments for the shifting of the existing utilities at each site location and all the existing utilities should be shifted on commencement of their construction. Charges payable to the utility agencies / Concerned line department shall be borne by the employer and paid directly to the departments by employer.

ii. Contractor shall be responsible for co-ordination and liaisoning with the concerned government departments for the purpose of obtaining all the permits/licenses/NOC/Clearances/any other statutory requirements for the purpose of construction of the facilities and shall make it readily available at site for any statutory inspection during their construction. Charges payable to the concerned department shall be borne by the contractor.

iii. At the commencement of work and from time to time, the contractor shall confer with other contractors, sub-contractors, persons engaged on separate contracts in connection with the project works, the suppliers, and with Employer's Representative for the purpose of the co-ordination and execution

of various phases of the project works. The contractor shall determine and ascertain from the other contractors, sub- contractors and persons engaged on separate contracts, in connection with the project works, the extent of all chasing, cutting and forming of all openings, holes, details of all inserts, sleeves, etc. that are required to accommodate the various services. The scope of work shall deemed to include all co-ordination activities required for execution of other contract packages such as Modular OT, CSSD, Laundry, Pneumatic Tube Systems, Medical Equipment, Medical Furniture, Laboratory Equipment, ICT, etc.

iv. The contractor shall determine and ascertain the routes of all services and the positions of all floor and wall openings, outlets, traps, the details of all inserts, equipment and services and shall carry out the construction and making good of all "builder's work" in accordance with and as shown, described and or measured in the drawings, specifications, schedule of quantities and other contract documents. Also, the contractor shall ensure that all required services, inserts, sleeves, embedment, etc. are in place/ position before he proceeds with his work. Should the contractor fail to comply with these requirements and the consequence of such failure necessitates the breaking, re-doing and making good of any work, then the cost of all such breaking, re-doing and making good of any work shall be to the account of the contractor and shall be borne by him. No breaking and cutting of completed work shall be done unless specifically authorised in writing by the Employer's Representative. No work shall be done over broken or patched work without first ascertaining that the broken surface is adequately prepared and reinforced to receive and hold further work, as determined by the Engineer.

v. Contractor shall attend coordination meetings at site or at employer's premises whenever requested and shall bear the expenses for attending the meeting. Contractor shall not delay the work for this reason. Contractor shall maintain records and minutes of meeting which shall be duly signed by the Employer's Representative and shall form part of the process of Handing Over.

vi. Contractor to establish & maintain 'Mock-ups' for various areas. The requirements of scope of work includes obtaining prior approvals for 'Mock-ups' for various areas such as lift lobby area, reception / registration area, waiting area, special and semi special wards, general wards, ICCU, Examination room, Director's room, sample façades, corridors, grand lobby, toilets, lecture theatres, laboratories, offices, typical gardens, typical road sections, boundary walls, all façade elements, painting colour schemes, or any other required area, works, etc., of the project before proceeding with selection of materials for execution. The work shall be executed using the sample makes approved in the 'Mock-ups'.

vii. The requirements of the scope of work shall include

a. preparation of shop drawings and as-built drawings to be approved by the employer or the Engineer of the employer.

- The shop drawings and as-built drawings shall include submission of drawings in BIM LOD 200. Also, all as-built drawings prepared and submitted by the construction contractor shall be in BIM LOD 200.

- For preparation of shop drawings, the construction contractor shall engage competent agencies who have carried out services for similar project defined in the PQ evaluation criteria.

b. Liaisoning and obtaining all utility connections. Charges payable to the utility agencies shall be borne by the employer.

viii. A full-fledged quality control laboratory shall be established at site as per standard CPWD guidelines. Cost towards any tests as advised by PMU/The Engineer, conducted other than at the site laboratory such as NABL accredited labs / IIT Guwahati / Centre for Urbanization, Buildings & Environment (CUBE) shall be borne by the contractor.

ix. The following documents shall also be applicable for execution of works.

i. CPWD's Standard Operating Procedures (SOP) for CPWD Works Manual 2022.

ii. SP27 - Handbook of Method of Measurement of Building Works - First Revision (Reaffirmed 2003) issued by Bureau of Indian Standards (BIS)"

FACILITIES FOR THE ENGINEER & THE DEPARTMENT

(a) Site Office- The contractor shall provide 1 No site office accommodations of approximately 650 sq.ft. area (as per layout plan approved by engineer-in-charge) & conference hall at location as specified by Engineer in charge for PWD, PIU & PMC including but not limited to following-

i) The site office accommodation shall be provided with all necessary furniture, fitted with all electrical items like light, fans, air conditioners, heaters, all office utilities, good quality projector in conference room etc. and complete wiring, water supply, sewerage and drainage etc. The office should have Engineered marble flooring in common areas and vitrified tiles in rooms with UPVC windows and laminated flush door shutters. The toilet fixtures shall be as per specifications mentioned in this document. The Agency shall provide necessary Air Conditioners, lighting and fixtures i/c fan, RO etc.

ii) The contractor shall provide the office accommodation within 03 (Three) months from the date of commencement of work.

iii) The contractor shall arranges to maintain the site offices which includes watch and ward, day to day up keeping of the building and surroundings, periodic whitewashing/ color washing of the building including utilities, payment of AMC charges, Electricity bill, water supply bills, RO/drinking water bills etc.

iv) The cost of construction, cost of all furniture (of Godrej/Wipro), fittings/fixtures/electrical fittings etc. and cost of maintenance and the related service charges of the site office building is deemed to be included in the quoted rates of work and nothing extra shall be payable. After completion of work, the contractor has to dismantle the site office and clear the site. This site office accommodation shall be maintained properly till completion of work and no claim whatsoever shall be entertained on the ground whether the delay in completion of work has

been attributable to the Department or to the contractor.

(b) Communication and Commuting

i) The contractor shall provide 2 Nos. laptop-cum-tablet) and 02 Nos. All-in-one Desktop (window 10) with 4G/5G enabled internet connection for the Engineer & his staff memebers. The contractor shall also provide 2 nos. Color laser printer (A3 Size) to the department. These accessories shall be retained by the department and the quoted rates are deemed to be inclusive of this cost. No additional payment shall be made to the Contractor on this account. The computer shall be provided with software viz. with MS-project, MS office, Auto Cad,etc.

ii) The contractor shall make arrangement for Helmets and leather shoes (meant of construction work at sites) for all field staff of the department during the entire period of construction for safety reasons. One helmet and one pairs of shoes per staff member (maximum ten members) of the departments per year shall be arranged by the contractor.

(c) IP Based CCTV:

i) The contractor shall provide IP Based CCTV (in sufficient number to capture/monitor whole site) with all requisite softwares, hardwares and accessories. A monitoring room with digital screens shall be made in site office. Remote monitoring facilities of the CC TV footage shall also be ensured by the Contractor.

2.22. FINISHING SCHEDULE

UDALGURI DISTRICT HOSPITAL

GROUND FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Cmo room	Gf - 01	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600
2	Cmo room attached toilet	Gf - 02	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
3	Police post	Gf - 03	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
4	Entrance lobby	Gf - 04	18mm tk. Polished granite laid	-	12mm thk granite of approved colour upto 2100mm height+plaster finish+two coats putty+primer +acrylic emulsion paint upto false ceiling.	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
5	8 beds(observation)	Gf - 05	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer + polyurethene paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600
6	6 beds triage	Gf - 06	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer + polyurethene paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600
7	Duty doctor	Gf - 07	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
8	Duty doctor attached toilet	Gf - 08	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
9	Resuscitation	Gf - 09	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer + polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
10	Sluice	Gf - 10	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	
11	Recovery	Gf - 11	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					+ acrylic emulsion paint	
12	Sterile store	Gf - 12	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer +anti bacterial acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
13	Medication	Gf - 13	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
14	Ch	Gf - 14	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
15	Scrub	Gf - 15	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer +anti bacterial acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
16	Minor ot/treatment room	Gf - 16	Conductive vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer + polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
17	Du	Gf - 17	300 x 300mm antiskid ceramic tiles of 7-	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			9mmthk of approved colour laid		upto 2100mm height + cement paint upto false ceiling	
18	6 beds attached toilet	Gf - 18	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
19	Pharmacy	Gf - 19	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600
20	Nurse lounge attached toilet	Gf - 20	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
21	Nurse lounge	Gf - 21	Double charged vitrified tiles (600 x 600) of	Vitrified tile	Plaster finish+two coats putty+primer +acrylic	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			approved colour		emulsion paint	
22	Emergency lab	Gf - 22	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
23	Ultra sonography	Gf - 23	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600
24	Ultra sonography attached toilet	Gf - 24	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
25	Electrical room	Gf - 25	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
26	Elv room	Gf - 26	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
27	Fire command control room	Gf - 27	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
28	Ahu room	Gf - 28	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
29	Store/mobile x-ray	Gf - 29	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board
30	Public toilet (m)	Gf - 30	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					upto false ceiling	
31	Ph toilet	Gf - 31	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
32	Public toilet (f)	Gf - 32	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
33	Mgps room	Gf - 33	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
34	Sample collection (f)	Gf - 34	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster	Gypsum plain board with mineral fibre ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					finish+two coats putty+primer + acrylic emulsion paint	
35	Sample collection (m)	Gf - 35	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre ceiling tiles 600 x 600
36	Ch	Gf - 36	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
37	Air lock	Gf - 37	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					finish+two coats putty+primer + acrylic emulsion paint	
38	Recovery	Gf - 38	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
39	Upper gi	Gf - 39	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
40	Disinfect	Gf - 40	300 x 300mm antiskid ceramic	-	300 x 450mm ceramic tile of 6-8mm thick of approved	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles of 7-9mmthk of approved colour laid		colour dado upto 2100mm height + cement paint upto false ceiling	
41	Disinfect	Gf - 41	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
42	Utility	Gf - 42	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
43	Utility	Gf - 43	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
44	Back office/record	Gf - 44	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
45	Radiologist room	Gf - 45	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
46	Radiologist room attached toilet	Gf - 46	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
47	Mri ahu	Gf - 47	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
48	Mri scan	Gf - 48	2mm tk. Anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
49	Lower gi	Gf - 49	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
50	X-ray	Gf - 50	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
51	Flouroscopy	Gf - 51	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
52	Ups	Gf - 52	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
53	Dining	Gf - 53	18mm thk. Polished kota stone laid	Vitrified tile	300 x 450mm ceramic tile of 6-8mm thick of approved	Gypsum plain board with metal grid false ceiling tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					colour dado upto 2100mm height + cement paint upto false ceiling	600 x 600
54	Equipment store	Gf - 54	18mm thk. Polished kota stone laid	Kota stone	Plaster finish+primer +2 coats oil bound distemper	-
55	Console	Gf - 55	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
56	Ct scan	Gf - 56	2mm tk. Anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer +acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
57	Equipment store	Gf - 57	18mm thk. Polished kota stone laid	Kota stone	Plaster finish+primer +2 coats oil bound distemper	-
58	Technician room	Gf - 58	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
59	Ahu room	Gf - 59	Ips flooring	-	Plaster finish+primer +2 coats oil bound distemper	-
60	Linen	Gf - 60	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
61	Du	Gf - 61	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
62	House keeping	Gf - 62	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
63	Toilet (f)	Gf - 63	300 x 300mm antiskid ceramic	-	300 x 450mm ceramic tile of 6-8mm thick of approved	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles of 7-9mmthk of approved colour laid		colour dado upto 2100mm height + cement paint upto false ceiling	
64	Toilet (m)	Gf - 64	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
65	Wash area attached toilet(m)	Gf - 65	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
66	Trolley bay	Gf - 66	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board with metal grid false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
67	Wash area	Gf - 67	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
68	Kitchen	Gf - 68	18mm thk. Polished kota stone laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
69	Corridor		Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer +oil bound distemper upto false ceiling	Gypsum plain board with metal grid false ceiling tiles 600 x 600
70	Lift lobby	Ll-01,ll-02	18mm tk. Polished granite laid	-	Granite dadooing with cement mortar shall be provided 2100 mm high in	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					lift facia wall only (refer lift lobby drawing) and other side walls with skirting+acrylic emulsion paint	
71	Ramp		Chequered tile (300x300) of approved colour	-	300x600mm ceramic tile of 6-8mm thick of approved colour dado upto 1500mm height or window sill height + primer + oil bound distemper upto false ceiling	-
72	Staircase	St-01,02,03,04	18mm thk. Polished kota stone laid	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	-

FIRST FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Toilet(f)	Ff - 01	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
2	Toilet(m)	Ff - 02	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
3	Ent consultation room	Ff - 03	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
4	Psychiatry consultation room	Ff - 04	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
5	Rehabilitation / physiothe	Ff - 05	Double charged vitrified tiles	Vitrified tiles	Plaster finish+two coats	Gypsum plain board with mineral fibre

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
	raphy		(600 x 600) of approved colour		putty+primer+ acrylic emulsion paint	false ceiling tiles 600 x 600
6	Refractio n room	Ff - 06	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
7	Opthalmo logy consultati on room	Ff - 07	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
8	Pediatrics consultati on room	Ff - 08	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
9	Plastre room/plas ter cutting	Ff - 09	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
10	Orthopedi cs consultati on room	Ff - 10	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
11	Treatment /procedur e room	Ff - 11	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+	Gypsum plain board with mineral fibre false ceiling

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					polyurethene paint	tiles 600 x 600
12	Dental consultation room	Ff - 12	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
13	Injection room(m)	Ff - 13	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
14	Injection room(f)	Ff - 14	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
15	Obst&gyn consultation room	Ff - 15	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
16	General surgery consultation room	Ff - 16	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
17	Treatment /procedure room	Ff - 17	2mm thk anti static vinyl flooring	Vitrified tiles	Plaster finish+two coats putty+primer+	Gypsum plain board with mineral fibre false ceiling

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					polyurethene paint	tiles 600 x 600
18	General medicine consultation room	Ff - 18	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
19	Electrical room	Ff - 19	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
20	Elv room	Ff - 20	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
21	Store	Ff - 21	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
22	Ahu room	Ff - 22	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
23	Class iv	Ff - 23	Double charged vitrified tiles (600 x 600)	Vitrified tile	300 x 450mm ceramic tile of 6-8mm thick of approved	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			of approved colour		colour dado upto 2100mm height + cement paint upto false ceiling	
24	Pantry	Ff - 24	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	-
25	Public toilet(m)	Ff - 25	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
26	Ph toilet	Ff - 26	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
27	Public toilet(f)	Ff - 27	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
28	Lecture room	Ff - 28	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
29	Pantry	Ff - 29	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	-
30	Linen store	Ff - 30	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
31	Male ward(8 beds)	Ff - 31	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
32	Male ward(7 beds)	Ff - 32	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
33	Cu	Ff - 33	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
34	Duty doctor attached toilet	Ff - 34	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
35	Duty doctor	Ff - 35	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
36	Treatment room	Ff - 36	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
37	Medication	Ff - 37	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
38	Female ward (7 beds)	Ff - 38	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
39	Female ward (8 beds)	Ff - 39	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
40	Du	Ff - 40	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
41	Hk	Ff - 41	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
42	Nurse lounge	Ff - 42	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+ acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
43	Nurse lounge attached toilet	Ff - 43	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
44	In-patient toilet(m)	Ff - 44	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
45	Ph toilet	Ff - 45	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
46	Hk	Ff - 46	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
47	In-patient toilet(f)	Ff - 47	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
48	Corridor		Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+	Gypsum plain board with metal grid false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					oil bound distemper upto false ceiling	
49	Lift lobby	Ll-01,ll-02	18mm tk. Polished granite laid	Granite	Granite dadooing with cement mortar shall be provided 2100 mm high in lift facia wall only (refer lift lobby drawing) and other side walls with skirting+acrylic emulsion paint	Gypsum plain board
50	Ramp		Chequered tile (300x300) of approved colour	-	300x600mm ceramic tile of 6-8mm thick of approved colour dado upto 1500mm height or window sill height + primer + oil bound distemper upto false ceiling	-
51	Staircase	St-01,02,03,04	18mm thk. Polished kota stone laid	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					+ above dado plaster finish+two coats putty+primer + acrylic emulsion paint	

SECOND FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Ward (6 beds)	Sf - 01	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
2	Ward (6 beds)	Sf - 02	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					emulsion paint	
3	Patient toilet(f)	Sf - 03	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
4	Patient toilet(m)	Sf - 04	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
5	Ward (6 beds)	Sf - 05	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
6	Medication	Sf - 06	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board
7	Linen	Sf - 07	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
8	Ward	Sf - 08	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
9	Nurse lounge	Sf - 09	Double charged vitrified	Vitrified tile	Plaster finish+two coats	Gypsum plain board with metal grid false ceiling

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles (600 x 600) of approved colour		putty+primer+acrylic emulsion paint	tiles 600 x 600 tiles
10	Nurse lounge attached toilet	Sf - 10	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
11	Doctor room attached toilet	Sf - 11	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
12	Doctor room	Sf - 12	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
13	Ward (6 beds)	Sf - 13	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					finish+two coats putty+primer + acrylic emulsion paint	
14	Doctor room attached toilet	Sf - 14	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
15	Doctor room	Sf - 15	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
16	Nurse lounge	Sf - 16	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
17	Nurse lounge attached toilet	Sf - 17	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
18	Du	Sf - 18	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
19	Cu	Sf - 19	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
20	Treatment room	Sf - 20	2mm thk anti static vinyl flooring	Vitrified tiles	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
21	Du	Sf - 21	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
22	Cu	Sf - 22	300 x 300mm antiskid ceramic	-	300 x 450mm ceramic tile of 6-8mm thick of approved	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles of 7-9mmthk of approved colour laid		colour dado upto 2100mm height + cement paint upto false ceiling	
23	Patient toilet	Sf - 23	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
24	Electrical room	Sf - 24	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
25	Elv room	Sf - 25	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
26	Ahu room	Sf - 26	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
27	Store	Sf - 27	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					ceiling	
28	Pantry	Sf - 28	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	-
29	Class iv	Sf - 29	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
30	Public toilet(m)	Sf - 30	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
31	Ph toilet	Sf - 31	300 x 300mm antiskid ceramic tiles of 7-	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			9mmthk of approved colour laid		upto 2100mm height + cement paint upto false ceiling	
32	Public toilet(f)	Sf - 32	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
33	Recovery	Sf - 33	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
34	Air lock	Sf - 34	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					emulsion paint	
35	Septic delivery	Sf - 35	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer+anti bacterial acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
36	Toilet	Sf - 36	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
37	Store	Sf - 37	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
38	Du	Sf - 38	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
39	Cu	Sf - 39	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
40	Pre natal ward	Sf - 40	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
41	Nicu	Sf - 41	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
42	Sluice	Sf - 42	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			colour laid		paint upto false ceiling	
43	Medication room	Sf - 43	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board
44	Feeding room	Sf - 44	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board
45	Du	Sf - 45	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
46	Toilet	Sf - 46	300 x 300mm antiskid ceramic tiles of 7-	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			9mmthk of approved colour laid		height + cement paint upto false ceiling	
47	Post natal ward	Sf - 47	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
48	Cu	Sf - 48	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
49	Nurse lounge	Sf - 49	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
50	Nurse lounge attached toilet	Sf - 50	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
51	Duty doctor	Sf - 51	Double charged	Vitrified tile	Plaster finish+two	Gypsum plain board with metal

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			vitrified tiles (600 x 600) of approved colour		coats putty+primer+acrylic emulsion paint	grid false ceiling tiles 600 x 600 tiles
52	Duty doctor attached toilet	Sf - 52	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
53	Toilet(m)	Sf - 53	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
54	Toilet(f)	Sf - 54	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
55	Doc ch(f)	Sf - 55	300 x 300mm antiskid ceramic tiles of 7-9mmthk of	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			approved colour laid		height + cement paint upto false ceiling	
56	Doc ch(m)	Sf - 56	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
57	Disinfection room	Sf - 57	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
58	Sluice	Sf - 58	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
59	Delivery room	Sf - 59	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					plaster finish+two coats putty+primer+anti bacterial acrylic emulsion paint	
60	Tssu sterile	Sf - 61	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer+anti bacterial acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
61	Flash sterilization	Sf - 62	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
62	Connecting corridor	Sf - 63	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					oil bound distemper upto false ceiling	
63	Blood store	Sf - 64	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer+anti bacterial acrylic emulsion paint	Gypsum plain board
64	Anesthesia store	Sf - 65	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board
65	Ot store	Sf - 66	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					finish+two coats putty+primer+anti bacterial acrylic emulsion paint	
66	Clean supply	Sf - 67	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
67	Ahu room	Sf - 68	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
68	Du	Sf - 69	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
69	Corridor		Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound	Gypsum plain board with metal grid false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					distemper upto false ceiling	
70	Lift lobby	Ll-01,ll-02	18mm tk. Polished granite laid	Granite	Granite dadooing with cement mortar shall be provided 2100 mm high in lift facia wall only (refer lift lobby drawing) and other side walls with skirting+acrylic emulsion paint	Gypsum plain board
71	Ramp		Chequered tile (300x300) of approved colour	-	300x600mm ceramic tile of 6-8mm thick of approved colour dado upto 1500mm height or window sill height + primer + oil bound distemper upto false ceiling	-
72	Staircase	St-01,02,03,04	18mm thk. Polished kota stone laid	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					finish+two coats putty+primer + acrylic emulsion paint	

THIRD FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Ward (6 beds)	Tf - 01	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
2	Ward (6 beds)	Tf - 02	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
3	Patient toilet(f)	Tf - 03	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
4	Janitor	Tf - 04	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
5	Patient toilet(m)	Tf - 05	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
6	Ward (6 beds)	Tf - 06	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer +	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					acrylic emulsion paint	
7	Medication	Tf - 07	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
8	Linen	Tf - 08	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
9	Cu	Tf - 09	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
10	Store	Tf - 10	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
11	Office area	Tf - 11	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
12	Nursing superintendent attached toilet	Tf - 12	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
13	Nursing superintendent	Tf - 13	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
14	Conference	Tf - 14	Wooden plank flooring	Wooden	75mm thk. Laminated wooden panelling upto 1200mm + above wooden	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					wall panelling 75mm thk. Acoustic wall panelling upto false ceiling + above false ceiling white wash	
15	Ward (6 beds)	Tf - 15	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
16	Rest room	Tf - 16	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
17	Pa	Tf - 17	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
18	Medical superintendent	Tf - 18	Double charged vitrified	Vitrified tile	Plaster finish+two coats	Gypsum plain board with mineral fibre

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles (600 x 600) of approved colour		putty+primer+acrylic emulsion paint	false ceiling tiles 600 x 600
19	Du	Tf - 19	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
20	Doctor room	Tf - 20	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
21	Doctor room attached toilet	Tf - 21	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
22	Nurse lounge	Tf - 22	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
23	Nurse lounge attached toilet	Tf - 23	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
24	Treatment room	Tf - 24	2mm thk anti static vinyl flooring	Vitrified tiles	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
25	Store	Tf - 25	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
26	Medical superintendent attached toilet	Tf - 26	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
27	Electrical room	Tf - 27	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					distemper	
28	Elv room	Tf - 28	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
29	Store	Tf - 29	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
30	Ahu room	Tf - 30	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
31	Class iv	Tf - 31	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
32	Pantry	Tf - 32	Double charged vitrified tiles (600 x 600) of approved	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			colour		height+plaster finish+primer+ oil bound distemper upto false ceiling	
33	Public toilet(m)	Tf - 33	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
34	Ph toilet	Tf - 34	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
35	Public toilet(f)	Tf - 35	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
36	Mrd	Tf - 36	Double charged vitrified tiles (600 x 600) of	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			approved colour		paint	
37	Ahu	Tf - 37	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
38	Linen store	Tf - 38	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
39	Male ward (8 beds)	Tf - 39	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
40	Male ward (7 beds)	Tf - 40	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					finish+two coats putty+primer + acrylic emulsion paint	
41	Cu	Tf - 41	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
42	Duty doctor attached toilet	Tf - 42	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
43	Duty doctor	Tf - 43	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
44	Treatment room	Tf - 44	2mm thk anti static vinyl flooring	Vitrified tiles	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
45	Female ward(7 beds)	Tf - 45	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
46	Female ward(8 beds)	Tf - 46	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
47	Medicatio n	Tf - 47	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
48	Store	Tf - 48	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
49	Nurse lounge	Tf - 49	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
50	Nurse lounge attached toilet	Tf - 50	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
51	In-patient toilet(m)	Tf - 51	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
52	Ph toilet	Tf - 52	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
53	Hk	Tf - 53	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
54	In-patient toilet(f)	Tf - 54	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
55	Du	Tf - 55	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
56	Corridor		Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	Gypsum plain board with metal grid false ceiling tiles 600 x 600
57	Lift lobby	Ll-01,ll-02	18mm tk. Polished granite laid	Granite	Granite dadooing with cement mortar shall be provided 2100 mm high in lift facia wall only (refer lift lobby drawing) and other side walls with skirting+acrylic emulsion paint	Gypsum plain board
58	Ramp		Chequered tile (300x300) of approved colour	-	300x600mm ceramic tile of 6-8mm thick of approved colour dado upto 1500mm height or window sill height + primer + oil bound distemper upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
59	Staircase	St-01,02,03,04	18mm thk. Polished kota stone laid	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	-

FOURTH FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Sluice	Fo - 01	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
2	ICU complex-(8 beds)	Fo - 02	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
3	DU	Fo - 03	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
4	CU	Fo - 04	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
5	ANTE	Fo - 05	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board
6	CU	Fo - 06	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
7	DU	Fo - 07	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
8	Isolation ICU	Fo - 08	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
9	Post operative ward(5 beds)	Fo - 09	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
10	Ch	Fo - 10	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
11	Change	Fo - 11	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
12	Equipment store	Fo - 12	18mm thk. Polished kota stone laid	Kota stone	Plaster finish+primer+ 2 coats oil bound distemper	-
13	Doctor room	Fo - 13	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
14	Nurse lounge	Fo - 14	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
15	Nurse lounge attached toilet	Fo - 15	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
16	Doctor room attached toilet	Fo - 16	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
17	Treatment room	Fo - 17	2mm thk anti static vinyl flooring	Vitrified tiles	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
18	Doctor room attached toilet	Fo - 18	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
19	Doctor room	Fo - 19	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
20	Nurse lounge	Fo - 20	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
21	Nurse lounge attached toilet	Fo - 21	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
22	Pantry	Fo - 22	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	-
23	Sterile	Fo - 23	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tiles	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
24	Hk	Fo - 24	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
25	Cu	Fo - 25	300 x 300mm antiskid ceramic	-	300 x 450mm ceramic tile of 6-8mm thick of approved	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles of 7-9mmthk of approved colour laid		colour dado upto 2100mm height + cement paint upto false ceiling	
26	Du	Fo - 26	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
27	Toilet	Fo - 27	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
28	Ot technician attached toilet	Fo - 28	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
29	Ot technician	Fo - 29	Double charged vitrified tiles (600 x 600) of	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			approved colour		paint	
30	Electrical room	Fo - 30	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
31	Elv room	Fo - 31	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
32	Ahu room	Fo - 32	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
33	Store	Fo - 33	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
34	Class iv	Fo - 34	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
35	Pantry	Fo - 35	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	-
36	Public toilet(m)	Fo - 36	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
37	Ph toilet	Fo - 37	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
38	Public toilet(f)	Fo - 38	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					ceiling	
39	Pre operarive ward	Fo - 39	2mm thk anti static vinyl flooring	Vinyl coving	Plaster finish+two coats putty+primer+ polyurethene paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
40	Du	Fo - 40	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
41	Pre operarive ward attached toilet	Fo - 41	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
42	Ot control station	Fo - 42	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					distemper upto false ceiling	
43	Store	Fo - 43	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
44	Toilet(m)	Fo - 44	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
45	Toilet(f)	Fo - 45	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
46	Doc ch (f)	Fo - 46	Double charged vitrified tiles (600 x 600) of	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			approved colour		upto 2100mm height + cement paint upto false ceiling	
47	Doc ch (m)	Fo - 47	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
48	Clean linen	Fo - 48	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
49	Ot technician	Fo - 49	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
50	Surgeons lounge	Fo - 50	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
51	Surgeons lounge attached toilet	Fo - 51	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
52	Anesthesian	Fo - 52	Double charged vitrified tiles (600 x 600) of approved colour	Vitrified tile	Plaster finish+two coats putty+primer+acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
53	Anesthesian attached toilet	Fo - 53	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-
54	Sluice	Fo - 54	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	
55	Recovery	Fo - 55	Double charged vitrified	Vitrified tiles	300 x 600mm ceramic tile of 6-8mm thick of	Gypsum plain board with mineral fibre

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			tiles (600 x 600) of approved colour		approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	false ceiling tiles 600 x 600
56	Du	Fo - 59	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
57	Tssu	Fo - 60	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer+anti bacterial acrylic emulsion paint	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
58	Electrical room	Fo - 61	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					distemper	
59	UPS	Fo - 62	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
60	Anesthesia store	Fo - 63	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board
61	Blood store	Fo - 64	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer+anti bacterial acrylic emulsion paint	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
62	OT store	Fo - 65	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600 tiles
63	Clean supply	Fo - 66	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600
64	Ahu room	Fo - 67	Ips flooring	-	Plaster finish+primer+ 2 coats oil bound distemper	-
65	Sterile zone	Fo - 68	Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm height + above dado plaster finish+two coats putty+primer+a	Gypsum plain board with mineral fibre false ceiling tiles 600 x 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					nti bacterial acrylic emulsion paint	
66	Change	Fo - 69	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
67	Clean zone	Fo - 70	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
68	Dirty zone	Fo - 71	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	Gypsum plain board
69	Change	Fo - 72	300 x 300mm antiskid ceramic tiles of 7-	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado	Gypsum plain board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			9mmthk of approved colour laid		upto 2100mm height + cement paint upto false ceiling	
70	Corridor		Double charged vitrified tiles (600 x 600) of approved colour	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height+plaster finish+primer+ oil bound distemper upto false ceiling	Gypsum plain board with metal grid false ceiling tiles 600 x 600
71	Lift lobby	Ll-01,ll-02	18mm tk. Polished granite laid	Granite	Granite dadooing with cement mortar shall be provided 2100 mm high in lift facia wall only (refer lift lobby drawing) and other side walls with skirting+acrylic emulsion paint	Gypsum plain board with metal grid false ceiling tiles 600 x 600
72	Ramp		Chequered tile (300x300) of approved colour	-	300x600mm ceramic tile of 6-8mm thick of approved colour dado upto 1500mm height or window sill height + primer + oil bound	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					distemper upto false ceiling	
73	Staircase	St-01,02,03,04	18mm thk. Polished kota stone laid	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	-

TERRACE FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Electrical room	Te - 01	Ips flooring	-	Plaster finish +primer+2 coats oil bound distemper	-
2	Laundry	Te - 02	300 x 300mm antiskid ceramic tiles of 7-9mmthk of approved colour laid	-	300 x 450mm ceramic tile of 6-8mm thick of approved colour dado upto 2100mm height + cement paint upto false ceiling	-

3	Ahu for ot	Te - 03	Ips flooring	-	Plaster finish +primer+2 coats oil bound distemper	-
4	Lift machine room	Lm - 01	Ips flooring	-	Plaster finish +primer+2 coats oil bound distemper	-
5	Lift machine room	Lm - 02	Ips flooring	-	Plaster finish +primer+2 coats oil bound distemper	-
6	Staircase	St-01,02,03,04	18mm thk. Polished kota stone laid	-	300 x 600mm ceramic tile of 6-8mm thick of approved colour dado 1500mm high + above dado plaster finish+two coats putty+primer + acrylic emulsion paint	-

SILCHAR DISTRICT HOSPITAL

GROUND FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	MRI Scan	GF - 01	2mm Tk. Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
2	Console	GF - 02	Double Charged Vitrified Tiles (600 X 600) Of	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Ac	Gypsum Plain Board With Mineral

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			Approved Colour		rylic Emulsion Paint	Fibre False Ceiling Tiles 600 X 600
3	Equipment Store	GF - 03	18 Mm Tk.Polished Kota Stone Laid	Kota Stone	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
4	Equipment Store	GF - 04	18 Mm Tk.Polished Kota Stone Laid	Kota Stone	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
5	CT Scan	GF - 05	2mm Tk. Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
6	Electrical Room	GF - 06	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
7	UPS Room	GF - 07	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
8	Flouroscopy	GF - 08	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
9	X-Ray	GF - 09	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
10	Reception	GF - 10	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board
11	Report Preparation	GF - 11	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board
12	Ultrasound	GF - 12	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
13	Ultrasound Attached Toilet	GF - 13	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
14	House Keeping	GF - 14	Double Charged Vitrified Tile (600 X 600) Of Approved	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
			Colour		2100mm Height + Cement Paint Upto False Ceiling	
15	PH. TOI	GF - 15	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
16	Public Toilet(F)	GF - 16	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
17	Public Toilet(M)	GF - 17	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
18	UPS	SF - 18	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
19	Radiologist Room	GF - 19	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
20	Radiolofist Room Attached Toilet	GF - 20	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
21	AHU For CT	GF - 21	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	Gypsum Plain Board
22	Change Room	GF - 22	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
23	Elv Room	GF - 23	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
24	Pacs	GF - 24	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
25	Film Store	GF - 25	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 601

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
26	Recovery	GF - 26	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 601
27	Store	GF - 27	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
28	UPS	SF - 28	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
29	AHU For MRI	GF - 29	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
30	Minor OT	GF - 30	Conductive Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	-
31	Record Room	GF - 31	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
32	Fire Command Control	GF - 32	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
33	Nurse Lounge	GF - 33	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
34	Nurse Lounge Attached Toilet	GF - 34	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
35	CMO Room	GF - 35	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	100mm Thk Vitrified Skirting	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
36	CMO Attached Toilet	GF - 36	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
37	Doctor Lounge	GF - 37	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
38	Doctor Lounge Attached Toilet	GF - 38	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
39	Change	GF - 39	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
40	Morgue	GF - 40	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
41	Police Post	GF - 41	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
42	Stretcher Bay	GF - 42	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
43	Pharmacy Store	GF - 43	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board
44	Resuscitation Room	GF - 44	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
45	Mobile X-Ray	GF - 45	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board
46	CU	GF - 46	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
47	DU	GF - 47	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
48	Nurse Station	GF - 48	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	
49	Red Zone 5 Beds	GF - 49	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
50	Sluice	GF - 49A	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
51	Emergency Triage Beds Yellow Zone	GF - 50	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
52	Stomach Wash	GF - 51	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
53	Toilet	GF - 52	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
54	Change	GF - 53	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
55	Scrub	GF - 54	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
56	Store	GF - 55	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
57	Isolation ICU	GF - 56	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats	Gypsum Plain Board With

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					Putty+Primer+ Polyurethene Paint	Mineral Fibre False Ceiling Tiles 600 X 600
58	AHU For Emergency	GF - 57	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
59	BMW	GF - 58	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
60	Waiting		Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
61	Corridor		Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
62	Lift Lobby	LL-01,LL-02,LL-03	18mm Tk. Polished Granite Laid	-	Granite Dadooing With Cement Mortar Shall Be Provided 2100 Mm High In Lift Facia Wall Only (Refer Lift Lobby Drawing) And Other Side Walls With Skirting+Acrylic Emulsion Paint	Gypsum Plain Board
63	Ramp		Chequered Tile (300 X 300) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 1500mm Height Or Window Sill Height + Primer + Oil Bound Distemper Upto False Ceiling	-
64	Staircase	ST-01,02,03	18 mm Tk.Polished Kota StoneLaid	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	-

FIRST FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Staff Male Toilet	FF - 01	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
2	Staff Female Toilet	FF - 02	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
3	Gen. Medicine	FF - 03	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finsish + Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
4	Gen. Medicine	FF - 04	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finsish + Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
5	Gen. Surgery	FF - 05	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finsish + Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
6	Gen. Surgery	FF - 06	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finsish + Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
7	Electrical Room	FF - 07	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
8	UPS	FF - 08	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
9	Pediatrics	FF - 09	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
10	Pediatrics	FF - 10	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish + Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
11	Recovery	FF - 11	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vinyl Coving	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High+Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					Paint	
12	Ph.Toi	FF - 12	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
13	Public Female Toilet	FF - 13	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	
14	Public Male Toilet	FF - 14	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
15	Injection Room(M)	FF - 15	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
16	Injection Room(F)	FF - 16	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
17	OBS-GYE	FF - 17	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
18	OBS-GYE	FF - 18	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
19	Upper GI	FF - 19	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
20	Change	FF - 20	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					Upto False Ceiling	
21	Store	FF - 21	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
22	Equip. Wash	FF - 22	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
23	Store	FF - 23	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
24	Equip. Wash	FF - 24	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
25	Lower GI	FF - 25	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
26	Change	FF - 26	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
27	Reception ForEndoscopy		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height +Plaster Finish + Primer + Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
28	Opthalmology	FF - 27	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
29	ENT	FF - 28	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Ac	Gypsum Plain Board With Mineral

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					rylic Emulsion Paint	Fibre Ceiling Tiles 600 X 600
30	Dental	FF - 29	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
31	Procedure Room	FF - 30	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
32	OPD Regestration	FF - 31	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
33	OPD Pharmacy	FF - 32	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
34	Refraction	FF - 33	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	100mm Thk Vitrified Skirting	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
35	Psychiatry	FF - 34	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
36	Orthopedics	FF -35	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
37	Orthopedics	FF -36	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
38	Toilet(M)	FF - 37	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
39	PH.TOI	FF - 38	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
40	Toilet(F)	FF - 39	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
41	House Keeping	FF - 40	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
42	Store	FF - 41	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
43	Pantry	FF - 42	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					Finish+Primer+Oil Bound Distemper Upto False Ceiling	
44	Staff Lounge	FF - 43	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
45	Staff Lounge Attached Toilet	FF - 44	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
46	Nurse Station	FF - 45	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
47	CU	FF - 46	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
48	DU	FF - 47	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
49	Nurse Lounge	FF - 48	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
50	Nurse Lounge Attached Toilet	FF - 49	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
51	Doctor Lounge	FF - 50	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
52	Doctor Lounge Attached Toilet	FF - 51	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
53	Speech Theraphy/ Rehabiltation	FF - 52	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tiles	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
54	Waiting		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
55	Corridor		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
56	Lift Lobby	LL-01,LL-02,LL-03	18mm Tk. Polished Granite Laid	-	Granite Dadooing With Cement Mortar Shall Be Provided 2100 Mm High In Lift Facia Wall Only (Refer Lift Lobby Drawing) And Other Side Walls With Skirting+Acrylic Emulsion Paint	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
57	Ramp		Chequered Tile (300 X 300) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 1500mm Height Or Window Sill Height + Primer + Oil Bound Distemper Upto False Ceiling	-
58	Staircase	ST-01,02,03	18 Mm Thick Polished Kota Stone Laid	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	-

SECOND FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Staff Female Toilet	SF - 01	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
2	Staff Male Toilet	SF - 02	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Of Approved Colour Laid		Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	
3	Toilet(F)	SF - 03	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
4	6 Bed Female Ward	SF - 04	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
5	6 Bed Female Ward	SF - 05	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
6	Elec. Room	SF - 06	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
7	UPS	SF - 07	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
8	7 Bed Female Ward	SF - 08	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
9	Isolation Room	SF - 10	2mm Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
10	Isolation Ward Attached Toilet	SF - 09	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
11	House Keeping	SF - 11	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
12	Ward Toilet(F)	SF - 12	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
13	6 Bed Female Ward	SF - 13	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
14	6 Bed Female Ward	SF - 14	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
15	CU	SF - 15	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
16	DU	SF - 16	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
17	Medication	SF - 17	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board
18	Nurse Lounge	SF - 18	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
19	Nurse Lounge Attached Toilet	SF - 19	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
20	Doctor Lounge Attached Toilet	SF - 20	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height +	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Cement Paint Upto False Ceiling	
21	Doctor Lounge	SF - 21	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
22	Linen Store	SF -22	300x300mm Antiskid Ceramic Tiles Of 7-9mm Thk Of Approved Colour Laid By Using Cement Mortar	-	300x450mm Ceramic Tile Of 6-8mm Thick Dado Upto 2100mm Hight Fixed Using Mortar + Cement Paint Upto False Ceiling	Gypsum Plain Board
23	CU	SF -23	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
24	DU	SF - 24	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
25	6 Bed Male Ward	SF - 25	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
26	6 Bed Male Ward	SF -26	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
27	6 Bed Male Ward	SF -27	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
28	6 Bed Male Ward	SF -28	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	600
29	PH TOI	SF - 30	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
30	Ward Toilet (F)	SF - 29	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
31	House Keeping	SF - 31	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
32	CU	SF -32	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
33	DU	SF -33	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
34	6 Bed Male Ward	SF -34	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
35	6 Bed Male Ward	SF -35	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
36	Nurse Lounge	SF - 36	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
37	Nurse Lounge Attached Toilet	SF - 37	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
38	Nurse Lounge	SF - 39	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
39	Nurse Lounge Attached Toilet	SF - 38	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
40	Doctor Lounge	SF - 40	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
41	Doctor Lounge Attached Toilet	SF - 41	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
42	Doctor Lounge	SF - 43	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
43	Doctor Lounge Attached Toilet	SF - 42	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
44	Medication Room	SF - 44	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty + Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
45	Toilet(M)	SF - 45	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
46	Waiting		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Finish+Primer+Oil Bound Distemper Upto False Ceiling	
47	Corridor		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
48	Lift Lobby	LL-01,LL-02,LL-03	18mm Tk. Polished Granite Laid	-	Granite Dadooing With Cement Mortar Shall Be Provided 2100 Mm High In Lift Facia Wall Only (Refer Lift Lobby Drawing) And Other Side Walls With Skirting+Acrylic Emulsion Paint	Gypsum Plain Board
49	Ramp		Chequered Tile (300x300) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 1500mm Height Or Window Sill Height + Primer + Oil Bound Distemper Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
50	Staircase	ST-01,02,03	18 mm Tk.Polished Kota Stone Laid	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	-

THIRD FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Public Male Toilet	TF - 01	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
2	PH.TOI	TF - 02	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
3	Public Female Toilet	TF - 03	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					+ Cement Paint Upto False Ceiling	
4	Doctor Lounge	TF - 04	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
5	Doctors Staff Attached Toilet	TF - 05	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
6	Labour - 1	TF - 08	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
7	Disinfection	TF -07	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid		300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
8	Toilet	TF - 06	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
9	Elec Room	TF - 09	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
10	UPS	TF - 10	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
11	Labour - 2	TF - 11	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
12	PH.TOI	TF - 12	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
13	Disinfection	TF -13	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Of Approved Colour Laid		Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	
14	Doctors Lounge	TF -14	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
15	Doctors Lounge Attached Toilet	TF - 15	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
16	AHU	TF - 16	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
17	Change	TF - 17	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
18	Scrub	TF - 19	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Distemper Upto False Ceiling	
19	TSSU Sterile	TF - 20	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
20	Corridor		Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
21	Nurse Lounge	TF -22	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
22	CU	TF -23	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Upto False Ceiling	
23	Nurse Lounge Attached Toilet	TF - 24	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
24	Anesthesia Store	TF - 25	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board
25	Blood Store	TF - 26	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
26	Labour -3	TF - 27	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
27	Disinfection	TF - 28	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
28	Toilet	TF -29	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
29	Sluice	TF - 30	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
30	Septic Delivery	TF - 31	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
31	Family Planing	TF - 32	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
32	AHU	TF -33	IPS Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
33	Staff Lounge	TF - 34	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
34	Staff Duty Attached Toilet	TF - 35	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+ Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
35	Duty Doctor Attached Toilet	TF - 36	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
36	Doctor Lounge	TF - 37	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
37	NICU	TF - 38	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
38	Ante Natal Ward	TF - 39	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
39	Ward Toilet	TF - 40	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
40	Nurse Station	TF -41	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
41	DU	TF -42	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
42	CU	TF -43	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
43	PH.TOI	TF -44	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
44	Female Ward toilet	TF -45	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Colour Laid		2100mm Height + Cement Paint Upto False Ceiling	
45	House Keeping	TF - 45A	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
46	Lecture Room	TF - 46	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
47	Doctor's Lounge	TF -47	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board
48	Staff Lounge	TF -48	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
49	Post Natal Ward	TF - 51	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
50	Post Natal Ward Attached Toilet	TF - 52	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
51	In Born	TF - 57	2mm Tk.Anti Static Vinyl Flooring	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
52	Out Born	TF - 58	2mm Tk.Anti Static Vinyl Flooring	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty + Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
53	Feeding Room	TF -59	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish +Two Coats Putty + Primer+ Polyurethene Paint	Gypsum Plain Board
54	Prep	TF - 60	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 601

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
55	Sluice	TF - 53	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
56	CU	TF -52	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
57	DU	TF -61	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
58	Store	TF - 55	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
59	Pantry	TF - 56	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Finish+Primer+Oil Bound Distemper Upto False Ceiling	
60	Waiting		Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
61	Lift Lobby	LL-01,LL-02,LL-03	18mm Tk. Polished Granite Laid	-	Granite Dadooing With Cement Mortar Shall Be Provided 2100 Mm High In Lift Facia Wall Only (Refer Lift Lobby Drawing) And Other Side Walls With Skirting+Acrylic Emulsion Paint	Gypsum Plain Board
62	Ramp		Chequered Tile (300 X 300) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 1500mm Height Or Window Sill Height + Primer + Oil Bound Distemper Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
63	Staircase	ST-01,02,03	18 mm Tk.Polished Kota StoneLaid	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	-

FOURTH FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Staff Male Toilet	FO - 01	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
2	Staff Female Toilet	FO - 02	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
3	Ward Toilet(M)	FO - 03	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
4	6 Beds male Ward	FO -04	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
5	6 Beds Male Ward	FO -05	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
6	Elec Room	FO - 06	Ips Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
7	UPS	FO - 07	Ips Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
8	7 Beds Female Ward	FO -08	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
9	Isolation Room	FO - 09	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
10	Isolation Ward Attached Toilet	FO - 10	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
11	House Keeping	FO - 11	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300x450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto Ceiling	-
12	PH.Toi	FO - 12	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
13	Ward Toilet(F)	FO - 13	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
14	6 Beds female Ward	FO -14	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
15	6 Beds female Ward	FO -15	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish + Two Coats Putty + Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
16	CU	FO -16	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
17	DU	FO -17	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
18	Medicatio n	FO - 18	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
					Dado Plaster Finish + Two Coats Putty + Primer + Acrylic Emulsion Paint	
19	Nurse Lounge	FO -19	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
20	Nurse Lounge Attached Toilet	FO - 20	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
21	Doctors Lounge Attached Toilet	FO - 21	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
22	Doctors Lounge	FO -22	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
23	General Office	FO - 23	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Metal Grid False Ceiling 600x600 + Gypsum Band

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
24	Medical Officer	FO - 24	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Mineral Grid False Ceiling 600x600 + Gypsum Band
25	Medical Officer Attached Toilet	FO - 25	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
26	AHU	FO - 26	Ips Flooring	-	Plaster Finish+Primer+2 Coats Oil Bound Distemper	-
27	PA	FO - 27	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Fibre False Ceiling Tiles 600 X 600
28	Nurse Superintendent	FO - 28	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
29	Nurse SuperintendentAttached Toilet	FO -29	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
30	Deputy Medical L/ Superintendent	FO - 30	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
31	Deputy Medical L/ Superintendent Attached Toilet	FO -31	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
32	PA	FO - 32	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Fibre False Ceiling Tiles 600 X 600
33	Male Toilet	FO -33	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile of 6-8mm Thick of Approved Colour Dado upto 2100 mm Height + Cement Paint upto false Ceiling	-
34	PH Toilet	FO -34	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
35	Female Toilet	FO -35	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
36	House Keeping	FO - 36	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300x450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto Ceiling	-
37	Medical Record	FO - 37	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board
38	PA	FO - 38	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Fibre False Ceiling Tiles 600 X 600
39	Superintendent	FO - 39	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
40	Superintendent Attached Toilet	FO -40	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Colour Laid		2100mm Height + Cement Paint Upto False Ceiling	
41	Meeting Room	FO -41	Wooden Plank Flooring	-	75 Mm Thk. Laminated Wooden Panelling Upto 1200mm + Above Wooden Wall Panelling 75mm Thk. Acoustic Wall Panelling upto False Celling + Above False Celling White Wash	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
42	File Store	FO - 42	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board
43	General Store	FO - 43	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
44	Pantry	FO - 44	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
45	Waiting		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
46	Corridor		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
47	Lift Lobby	LL-01,LL-02	18mm Tk. Polished Granite Laid	-	Granite Dadooing With Cement Mortar Shall Be Provided 2100 Mm High In Lift Facia Wall Only (Refer Lift Lobby Drawing) And Other Side Walls With Skirting + Acrylic Emulsion Paint	Gypsum Plain Board
48	Ramp		Chequered Tile (300x300) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 1500mm Height Or Window Sill Height + Primer + Oil Bound Distemper Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
49	Staircase	ST-01,02,03	18 Mm Thick Polished Kota Stone Laid Using Cement Mortor	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish +Two Coats Putty+Primer + Acrylic Emulsion Paint	-

FIFTH FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	Staff Male Toilet	FI - 01	300x300mm Antiskid Ceramic Tiles Of 7-9mm Thk Of Approved Colour Laid By Using Cement Mortar	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
2	PH. Toi	FI - 02	300x300mm Antiskid Ceramic Tiles Of 7-9mm Thk Of Approved Colour Laid By Using Cement Mortar	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
3	Staff Female Toilet	FI - 03	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
4	Issuing Counter	FI - 04	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	12mm Thk Granite Of Approved Colour Upto 2100mm Height+Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint Upto False Ceiling.	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
5	Stelerization Store	FI - 05	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board
6	Stelerization	FI - 06	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
7	CSSD Incharge	FI - 07	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty+Primer + Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
8	Dirty Receiving	FI - 08	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height +	Gypsum Plain Board With Mineral Fibre Ceiling

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Colour Laid		Cement Paint Upto False Ceiling	Tiles 600 X 600
9	Trolley Wash	FI - 09	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
10	Wash / Disinfection	FI - 10	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
11	Elec Room	FI - 11	IPS Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound Distemper	-
12	UPS	FI - 12	IPS Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound Distemper	-
13	Anesthetist	FI - 13	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
14	Doctors Lounge	FI - 14	Double Charged Vitrified Tiles (600 X 600) Of	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Ac	Gypsum Plain Board With Metal Grid False

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Approved Colour		rylic Emulsion Paint	Ceiling Tiles 600 X 600
15	Nurse Lounge	FI -15	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
16	Dirty Corridor	FI - 16	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board
17	CU	FI - 19	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
18	Scrub,Patient Hold	FI - 20	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
19	Medicine/Drug	FI - 21	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Mineral Fibre False Ceiling Tiles 600 X 600
20	Equipment	FI - 22	18 Mm Tk.Polished Kota Stone	Kota Stone	Plaster Finish +Primer+2 Coats Oil Bound Distemper	-
21	Blood Storage	FI - 23	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm Height + Above Dado Plaster Finish+Two Coats Putty+Primer+Anti Bacterial Acrylic Emulsion Paint	Gypsum Plain Board
22	AHU	FI - 24	IPS Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound Distemper	-
23	Drug /Linen	FI - 25	300x300mm Antiskid Ceramic Tiles Of 7-9mm Thk Of Approved Colour Laid By Using Cement Mortar	-	300x450mm Ceramic Tile Of 6-8mm Thick Dado Upto 2100mm Hight Fixed Using Mortar + Cement Paint Upto False Ceiling	Gypsum Plain Board
24	Store	FI - 26	Double Charged Vitrified Tiles (600 X 600) Of Approved	-	300x450mm Ceramic Tile Of 6-8mm Thick Dado Upto 2100mm Hight	

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
			Colour		Fixed Using Mortar + Cement Paint Upto False Ceiling	
25	Change	FI - 27	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
26	Change	FI - 28	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
27	Pre Operarive Beds	FI - 29	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
28	Pre Operative Beds Attached Toilet	FI -30	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
29	Change	FI - 31	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
30	ICU	FI - 32	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
31	ICU Attached Toilet	FI -33	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
32	Sluice	FI - 34	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid		300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	
33	Isolation	FI - 35	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
34	Isolation Attached Toilet	FI -36	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
35	Isolation	FI - 38	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
36	Isolation Attached Toilet	FI -37	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
37	Treatment	FI - 39	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty+Primer+ Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
38	Treatment Attached Toilet	FI -40	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
39	Male Ward Toilet	FI -41	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
40	PH.Toi	FI -42	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
41	Female Ward Toilet	FI -43	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
42	House Keeping	FI - 44	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300x450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto Ceiling	-
43	Nurse Station	FI - 45	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+O	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					il Bound Distemper Upto False Ceiling	
44	CU	FI - 46	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
45	DU	FI - 47	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
46	Post Operarive Beds	FI - 48	2mm Tk.Anti Static Vinyl Flooring	Vinyl Coving	Plaster Finish+Two Coats Putty + Primer + Polyurethene Paint	Gypsum Plain Board With Mineral Fibre Ceiling Tiles 600 X 600
47	Sluice	FI - 49	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
48	Post Operarive Ward Attached Toilet	FI -50	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
49	CU	FI - 51	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
50	DU	FI - 52	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board
51	Nurse Lounge	FI -53	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
52	Nurse Lounge Attached Toilet	FI -54	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
53	Nurse Lounge Attached Toilet	FI -56	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
54	Nurse Lounge	FI -55	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
55	Doctors Lounge	FI -57	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
56	Doctors Lounge Attached Toilet	FI -58	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
57	Doctors Incharge Attached Toilet	FI -59	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
58	Doctors Incharge	FI -60	Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	Vitrified Tile	Plaster Finish+Two Coats Putty+Primer+Acrylic Emulsion Paint	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
59	Linen Store	FI - 61	300x300mm Antiskid Ceramic Tiles Of 7-9mm Thk Of Approved Colour Laid By Using Cement Mortar	-	-	Gypsum Plain Board
60	Dining	FI - 62	18 Mm Tk.Polished Kota Stone Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Dado Upto 1500mm Height Fixid Using Mortar+Cement Paint Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
61	Pantry	FI- 63	Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	
62	Waiting		Double Charged Vitrified Tile (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+O	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					il Bound Distemper Upto False Ceiling	
63	Corridor		Double Charged Vitrified Tiles (600 X 600) Of Approved Colour	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height+Plaster Finish+Primer+Oil Bound Distemper Upto False Ceiling	Gypsum Plain Board With Metal Grid False Ceiling Tiles 600 X 600
64	Lift Lobby	LL-01,LL-02	18mm Tk. Polished Granite Laid	-	Granite Dadooing With Cement Mortar Shall Be Provided 2100 Mm High In Lift Facia Wall Only (Refer Lift Lobby Drawing) And Other Side Walls With Skirting + Acrylic Emulsion Paint	Gypsum Plain Board
65	Ramp		Chequered Tile (300x300) Of Approved Colour	-	300x600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 1500mm Height Or Window Sill Height + Primer + Oil Bound Distemper Upto False Ceiling	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
66	Staircase	ST-01,02, 03	18 mm Thick Polished Kota Stone Laid	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty + Primer + Acrylic Emulsion Paint	#Value!

TERRACE FLOOR

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	SKIRTING (100MM)	WALL	CEILING
1	AHU Room for ICU	TE - 01	IPS Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound Distemper	-
2	Elec Room	TE - 02	IPS Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound Distemper	-
3	Laundry Room	TE - 03	300 X 300mm Antiskid Ceramic Tiles Of 7-9mmthk Of Approved Colour Laid	-	300 X 450mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado Upto 2100mm Height + Cement Paint Upto False Ceiling	-
4	AHU Room For OST-Operative Ward	TE - 04	Ips Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound Distemper	
5	Lift Machine Room	LM - 01,02, 03	Ips Flooring	-	Plaster Finish +Primer+2 Coats Oil Bound	-

S.NO.	ROOM NAME	ROOM NO	FINISHES			
			FLOORING	**SKIRTING (100MM)**	**WALL**	**CEILING**
					Distemper	
6	Staircase	ST-01,02, 03	18 Mm Thick Polished Kota Stone Laid	-	300 X 600mm Ceramic Tile Of 6-8mm Thick Of Approved Colour Dado 1500mm High + Above Dado Plaster Finish+Two Coats Putty + Primer + Acrylic Emulsion Paint	-

TECHNICAL SPECIFICATIONS FOR PLUMBING, WATER SUPPLY AND SANITARY INSTALLATION, SEWAGE TREATMENT PLANT & EFFLUENT TREATMENT PLANT INCLUDING SOLAR HOT WATER SYSTEM PUMP WORKS

3. TECHNICAL SPECIFICAION - PLUMBING WORKS

3.1. SCOPE OF WORK

The work shall generally conform to the latest CPWD Specifications as mentioned in the GCC. Work under this contract shall consist of providing all labor, materials, equipment, and appliances necessary and required for the execution. The Contractor is required to fully furnish all plumbing and other specialized services as described below and as specified in the GFC plumbing drawings.

3.2. GENERAL

The general scope of work to be carried out under this section includes the supply, installation, testing, commissioning, and successful handing over of a complete plumbing system, which includes:

- Internal and external water supply systems
- Internal and external soil/waste drainage systems
- Internal roof rainwater system+Internal and external storm water drainage systems
- Water treatment systems (e.g., RO systems)
- Hot water supply systems
- Water Treatment Plants (e.g., Iron Removal Plant)
- Sewage Treatment Plants and Effluent Treatment Plants

The work shall be carried out as mentioned in the Technical Specification, Bill of Quantities, and as detailed in the drawings. The Contractor shall execute and complete the work under this contract in full compliance with the rules and regulations of the local authority. The Contractor shall provide all necessary labor, materials, appliances, tools, and equipment required for the installation of plumbing services, including testing and commissioning, as specified herein and in accordance with the relevant Bureau of Indian standards (BIS), IS codes, and as shown in the drawings.

This also includes any materials, appliances, and equipment not specifically mentioned herein or noted on the drawings but which are necessary and customary to ensure a complete installation that is properly connected and in full working order.

Wherever brand names or makes are specified in these Technical Specifications, any equivalent brand or make will also be acceptable. The Contractor shall provide documentary evidence supporting the equivalence of the brand(s) and make(s) and shall use such equivalent brand(s) and make(s) only after obtaining approval from The Engineer.

Carry out all incidental works connected with the plumbing services installation, such as excavation of trenches and back filling, cutting and chasing in concrete or brickwork, and making good. This includes cutting/drilling holes through walls and floors, as well as grouting for the embedding and fixing of fixtures/equipment, and other related activities.

Provide and install a complete and functional plumbing services system as shown in the drawings and described in this specification, in accordance with the latest Bureau of Indian Standards (BIS) specifications. This includes all work reasonably inferred, both internally and externally, for all buildings.

a) Complete installation of the sewerage system and its appurtenances, both within and around the building.
b) Complete installation of all sanitary and plumbing fixtures on all floors of the buildings.
c) Coordination with other services, such as Electrical, Fire, HVAC, and MGPS, to ensure proper placement of the installation. Any work carried out without proper consideration or consultation with these services shall be removed by the Contractor, at no additional cost to the Employer, to allow for the correct installation of all other work as directed by the Engineer.
d) Repair any damage caused to the premises as a result of this installation and remove all debris left by those engaged in the installation, to the satisfaction of the Engineer.
e) Clean all plumbing and sanitary fixtures, test, and ensure the satisfactory performance of all fixtures at the time the buildings are handed over to the Employer. It is the Contractor's responsibility to maintain all fixtures until the time of handing over to the Employer.
f) Paint all concealed and exposed pipes as specified. Wrap and coat all underground GI pipes as required.
g) The Contractor shall take full responsibility for obtaining approval for all liaison work related to water supply, sewage drainage, and storm water drainage, including any associated expenses. The Contractor is also responsible for obtaining and delivering to the Employer the certificates of final inspection and approval from the concerned authorities.

Preparation of Shop Drawings

a. The Contractor shall submit Technical Data Sheet and Material Approval Sheet.

As Built Drawings

Upon completion of the works, the Contractor shall submit three sets of "As-Built" drawings and provide all drawings and information in the latest version of Auto CAD. These drawings shall include the following information:

a) The exact routes and sizes of all piping on all floors and vertical stacks.
b) Ground and invert levels of all drainage pipes, along with the locations of all manholes and connections up to the outfall.
c) The routes of all water supply lines, including diameters, and locations of control valves and access panels.
d) The locations of all mechanical equipment, including layout and piping connections.
e) The Contractor shall provide three sets of product catalogs, performance data, and a list of spare parts, along with the names and addresses of the manufacturers for all electrical and mechanical equipment provided.
f) All "Warranty Cards" issued by the manufacturers shall be handed over to the Engineer.
g) Three sets of operation and maintenance manuals in the required format shall be handed over to the Engineer.

Regulations and Standards

The installation shall conform in all respects to the following standards in general:

IS 7558 – 1974	Code of practice for domestic hot water installation
IS 5329 – 1983	Code of practice for sanitary pipe work above ground for buildings.
IS 12251 – 1987	Code of practice for drainage of building basements
Is 2064 – 1973	Code of practice for selection, installation and maintenance of sanitary appliances
IS 1200 (Part 1)	Method of measurement of building earthwork
IS 1200 (Part 16)	Method of measurement of laying of water and sewer lines including appurtenant
IS 1200 (Part 19)	Method of measurement of Water supply, plumbing and drains.
IS 783 – 1959	Code of practice for laying of concrete pipes
IS 13592 – 1992	Specification for unplasticized PVC pipes for soil and waste discharge system inside building including ventilation and rainwater
IS 2527 – 1984	Code of practice for fixing rainwater gutters and down pipes for roof drainage.

IS 2685 – 1971	Code of practice for selection, installation and maintenance of sluice valves.
IS 6784 – 1984	Method of performance testing of water meters (Domestic type).
IS 2692 – 1989	Specification of ferrules for water services
IS 12701 – 1989	Specification for rotational moulded polyethylene water storage tanks.
IS 771 – (Part 3 to 6)	Specific requirements for urinals.
IS 2548 (Part 1&2)	Specification for plastic seats and covers for water closets.
IS 3004 – 1979	Specification for plug cocks for water supply purposes.
IS 1711 – 1984	Specification for self closing taps for water supply
IS 1703 – 1977	Specification for ball valves (Horizontal plunger type) including floats for water supply purposes.
IS 4038 – 1979	Specification for foot valves for water works purposes.
IS 1172 – 1983	Code of basic requirements for water supply, drainage & sanitation (revised).
IS 1239 – 1990 (Part I)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239 – 1992 (Part II)	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1726 – 1991	Code for cast iron manhole frame and cover (third revision).
IS 1742 – 1983	Code of practice for building drainage. (Second revision)
IS 2064 – 1973	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065 – 1983	Code of practice for water supply to buildings.
IS 4111 – 1986	Code of practice for Ancillary structures in sewerage system
BS 4515	Specification for unplasticized PVC pipe fittings.
IS 4985 – 1988	Specification for unplasticized PVC pipes for portable water supplies (second revision)
IS 732 & IS 2274 – 1963	Indian Standard code of practice for electrical wiring & installation.
IS 780 – 1984	Specification for sluice valves for water works purposes.
IS 458 – 2003	Precast Concrete Pipes

ASTM –D2846	CPVC Hot and cold water distribution
ASTM – F493	CPVC Solvent cement specifications
ASTM – F402	Handling cement solvents
ASTM – F442	CPVC Plastic pipe (SDR - PR)
ASTM – F437	Threaded CPVC fittings Schedule 80
ASTM – F438	CPVC Schedule 40 CPVC fittings
ASTM – F439	CPVC Schedule 80 CPVC fittings
ASTM – F441	CPVC Schedule 40 & 80 pipe
ASTM – D1784	CPVC Compounds
ISO – 727	Dimensions of CPVC sockets
ASTM A182/A403, ASME SA182/SA 403	Stainless Steel Pipes & Fittings

IS 10446 – 1983	Glossary of terms relating to water supply and sanitation.
IS 11208 –1985	Guidelines for registration of Plumbers
IS 1701 – 1960	Specification for mixing valves for ablutionary and domestic purposes.
IS1711–1970	Specification for self closing taps.
IS 2963 – 1979	Specification for copper alloy waste fittings for wash basins and sinks.
IS 3004 – 1979	Specification for plug cocks for water supply purposes.
IS 3311 – 1979	Specification for waste plug and its accessories for sinks and wash basins.
IS775 – 1970	Specifications for CI brackets and supports for wash basins and sinks.
IS781 – 1977	Specifications cast copper alloy screw – down bib taps and stop valves for water supply.
IS 9758 – 1981	Specification for flush valves and fittings for water closets and urinals.
IS 9763 – 2000	Plastic Bib Taps, pillar taps, angle valves and stop valves for hot and cold water services.
IS 13983 – 1994	Stainless steel sinks for domestic purposes – Specification
IS 1700 – 1973	Specification for drinking fountains

IS 2064 – 1993	Code of Practice for selection, installation and maintenance of Sanitary appliances
IS 774 – 1984	Specification for – flushing cistern for water closets and urinals (Other than plastic cistern)
IS 2326 – 1987	Specification for automatic flushing cisterns for urinals
IS 2548 – part 1	Specification for plastic seats and covers for water closets (Part 1 Thermo-set seats and covers)
IS 2548 – part 1	Specification for plastic seats and covers for water closets (Part 2 Thermoplastic seats and covers)
IS 3489 – 1985	Specification for enameled steel bath tub
IS 6411 – 1985	Specification for gel coated glass fiber reinforced Polyester resin bath tub
IS 7231 –1984	Specification for plastic flushing cistern for water-Closets and urinals
IS 9110- 1979	Hand Operated Angers For Cleaning Water Closet & Pipes
IS 1795 – 1982	Specifications for Pillar taps for water supply purposes
IS 2556 – 1994	Specifications for the Vitreous Sanitary Appliances Part 1 - Part 14 (Vitreous china) (Part 1 general requirements)
IS 5961 – 1970	Specification for cast iron gratings for drainage Purposes
IS 779 -1978	Specifications for Water Meter s Domestic Type
IS 2104 – 1981	Specification for water meter boxes (Domestic type)
IS 2401–1973	Code of practice for selection, installation, and maintenance of domestic water meters.
IS 7413-1981	Insulation Material
IS 2065 –1983	Code of practice for Water Supply in Buildings (Second Revision)
IS 778- 1984	Specifications for copper alloy Gate, Globe and Check Valves for water supply purposes
IS 1703 – 1977	Specification for ball valves (horizontal plunger type) including floats for water supply purposes
IS 3004 – 1979	Specification for plug cocks for water supply purposes.
IS 3950 – 1979	Specifications for surface boxes for sluice valves.
IS 9338 – 1984	Specification for cast iron screw -down stop valves and stop and check valves for water works.
IS 4346 – 1982	Specification for washers for use with fittings for water services

IS 5219 – Part 1	Specification for cast copper alloy traps
IS 5312 – part 1	Specification for swing check type reflux (Non-return)
IS 13049 – 1919	Diaphragm type (plastic body) float operated valve for cold water services – specification
IS 13114 – 1991	Forged brass gate, globe and check valves for water works purposes – specification
IS 310 –1965	Code Of Practice for Water Supply
IS 2401 – 1973	Code of practice for selection, Installation and maintenance of domestic water meters
IS 780-1984	Specification for Sluice valves for water works purposes (50 to 300mm size) (sixth revision)
IS 10446 – 1983	Glossary of terms relating to water supply and sanitation.
IS 11208 –1985	Guidelines for registration of Plumbers
IS 5382 – 1985	Specification for rubber sealing rings for gas mains, water mains and sewers
IS 1172-1983	Code of Basic Requirement for Water Supply, drainage & sanitation third revision
IS 1200 - 1992	Method of Measurement Of Building And Civil Engineering Works (part- 1 earth work)
IS 2379 –1963	Specification of colour code for the identification of pipes
IS 1742 – 1983	Code of Practice for Building Drainage (Second Revision)
IS 301 – 1971	Code of practice for Building Drainage
IS12251- 1987	Code Of Practice For Drainage In Basement
BS 5572 -1978 (Amendment No.2)	Sanitary pipe Works
BS 4660- 1973 (Amendment No.1)	PVC Underground Drain Pipes & Fittings
IS 5329 – 1983	Code of practice for sanitary pipe work above ground for buildings First Revision)
IS 10446 – 1983	Glossary of terms relating to water supply and sanitation.
IS 11208 –1985	Guidelines for registration of Plumbers
IS 4111	Code of practice for Ancillary Structure In Sewerage System (part 1) 1986
IS 301 – 1971	Code of practice for Building Drainage

IS 651 1992	Specification for salt- glazed stoneware pipes and fittings
IS 1726 -1991	CI Manhole Covers and Frame
BS 5572 -1978 (Amendment No.2)	Sanitary pipe Works
IS 4127 – 1983	Specification for testing of stone ware pipes and fittings

National building Code 2016

CPHEEO Manuals

SP-35

SP-42, Uniform Plumbing Code and International Plumbing Code.

The installation shall also be in conformity with the bye laws and requirements of the local authority in so far as these become applicable to the installation. Wherever this specification calls for, a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then this specification shall take precedence over the said regulations and standards.

Wherever drawings and specifications require something that may conflict with the regulations, the regulations shall govern. This shall be referred to the Engineer for arbitration.

3.3.EXECUTION OF WORK

The work shall be carried out in conformity with the water supply and sanitary drawings and within the requirements of architectural, HVAC, Electrical, and other specialized services drawings.

The Contractor shall co-operate with all trades and agencies working on the site and make provision for hangers, sleeves, and structural openings and other requirements well in advance to prevent hold up or progress of the construction programe. Any work done without regard (or) consultation with other trades, shall be removed and rectified by the Contractor without additional cost to the Client.

The Contractor shall furnish and install a complete working, plumbing services installation as per approved drawings and as per the latest BIS codes of practice.

Execution of work by the Contractor includes complete installation of internal & external water supply system, sewerage and sewerage appurtenances internally as well as around the building, controllers, valves and power control wiring for controller etc. complete installation of all sanitary and plumbing fixtures.

It is the responsibility of the Contractor to protect all the installed fixtures and fittings until the time of handing over to the Client. The Contractor shall set out the drainage, soil, waste and water pipe lines and other fittings and fixtures in accordance with the Drawings and instructions of The Engineer. The Contractor shall be responsible for the correctness of the above and any incorrectness shall be rectified at his own cost and also for taking levels at site before setting out and putting them on record without extra charge.

The Contractor shall provide at all times during the progress of the works and during maintenance period proper facilities and necessary attendance for inspection or measurement of the works by the Engineer or their representatives.

3.4.FEES, PERMITS AND NOTICES

Contractor shall comply with all bye-laws and regulations of local and other statutory authorities having jurisdiction over the works and shall be responsible for the payment of all fees and other charges and giving and receiving of all necessary notices. Contractor shall keep the Engineer timely informed about regulations and requirements of statutory authorities and shall obtain the final certificates of inspection and approval from the authorities.

3.5.DRAWINGS AND SPECIFICATIONS

The drawings and specifications shall be considered part of this contract, and any work or materials shown on the drawings but not mentioned in the specifications, or vice versa, shall be executed as if specifically included in both. The Contractor shall obtain the necessary approvals from the Engineer for shop drawings.

The tender drawings indicate the extent and general arrangement of the fixtures, Pipe routings and sanitary routing system etc., and are essentially diagrammatic. The tender drawings indicate the points of supply and termination of work and broadly suggest the routes to be followed. The works shall be executed as indicated on the drawings. However, any changes found essential to co-ordinate with this work and other trades shall be made without any additional cost. The drawings and specifications are meant for the assistance and guidance of the Contractor, and exact location, distance and levels will be governed by the building and site conditions. Therefore, approval of the Engineer shall be obtained before commencement of work.

Plumbing Works Includes

Overall Plumbing Works Internal & External:

a) Plumbing Fixtures Chrome Plated Fittings & Accessories.
b) Soil, Waste & Vent Pipes & Fittings
c) Rainwater Pipes & Fittings
d) Internal / External Water Supply System (Cold & Hot)
e) External Sewerage & Drainage System
f) External Rainwater System
g) External Flushing Water System
h) Drinking Water System

Samples of all materials should be approved before placing order and the approved samples

shall be deposited with The Engineer. If directed, materials shall be tested in an approved testing laboratory and the Contractor shall produce the test certificate in original to The Engineer and the entire charges for original as well as repeated tests shall be borne by the Contractor. If required by The Engineer, the Contractor shall arrange to test portions of the work at his own cost in order to prove their soundness and efficiency. If after any such test the work or portions of work is found in the opinion of The Engineer, to be defective or unsound, the Contractor shall pull down and re-do the same at his own cost. Defective materials shall be removed from site.

3.6.PLUMBING FIXTURES:

Scope of work

All sanitary fixtures like sanitary ware, CP fittings, bath room accessories, wall flanges, valves and all related to bath room, kitchen utility fittings (CP and sanitary fittings). And also supply small accessory piping and any specialties furnished for fixtures such as adopters, pipe fittings, cement, brick work supports for AWC, CP Extension pieces, Check nuts, screws, washers, gasket etc., waste connector, WC connector, PVC or CP connection pipe, connecting nipple, screws, clamps, white cement wall flanges, washers, sealant and other accessories of this type as required.

Scope of installation to be performed by the Contractor is outlined below:

- The Contractor is responsible for installing the fixtures and fittings in good condition; otherwise, any damage caused to the fittings and fixtures will be born by the contractor.
- The Contractor shall hydrostatically test all the sanitary appliances and CP fittings installation including accessories and specialties.
- Contractor shall supply all Jointing material as required for all joints. Like screws, washers, sealants, Installation tools, tackles, drilling machine as required to complete the work.
- Tile Sanitary fixtures and fittings shall be installed at the correct aligned position as shown on the drawings and as directed by the engineer, and shall fully meet with the aesthetic and symmetrical requirements as required
- All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Project Engineer requirements. Wherever necessary the fittings shall be centered to dimensions pattern as called for.
- Fixture shall be installed by skilled plumber with appropriate tools according to the best trade practice. Manufacturer’s instruction shall be followed for the installation of fixtures. Fixtures in all toilets shall be standard height, mounting as called for on the drawings. Fixtures shall be mounted rigid, plumb and true to alignment
- All fixtures shall be fixed firmly to the floor / wall with accessories supplied by the manufacturer. Use chrome plated brass cap nuts for fixation screws.

- All ferrous accessories used for the installation of sanitary fixtures shall have anti-rust treatment given at the factory.
- Refer to interior architectural documents for details of toilet and bathroom accessories. These are part of the finishing works.
- Contractor shall do mock-up for each type of sanitary ware fittings &fixtures, before final installation.
- Care shall be taken in fixing all approved chromium plated (CP) fixtures and accessories so as not to leave any tool marks or damages on the finish. All such fixtures shall be tightened with fixed spanners.
- Use of `Stilton' type pipe wrenches with toothed jaws shall not be allowed.
- All fixtures shall be thoroughly tested after connecting the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping valves and waste fittings corrected to the complete satisfaction of the Engineer.
- Upon completion of the work, all labels, stickers, plaster, etc. shall be removed from the fixtures and all fixtures shall be cleaned with soap and water so as to present a neat and clean toilet.

3.7. MOCK UP AND TRIAL ASSEMBLY

The installation of the sanitary fixtures and shall be as per the GFC drawings approved by The Engineer.

The Contractor shall assemble on trial basis at least one set of each type of sanitary fixture and fittings in order to determine precisely the required supply and disposal "connections. Relevant instructions from manufacturer shall be followed as applicable. This trial, assembly shall be developed to facilitate determining the location of punctures, holes, holding devices etc, which will be required for final installation In position of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by The Engineer.

The fixtures in the trial assembly can be reused for final installation without any additional payments for fixing or dismantling of the fixtures.

Operation & maintenance training to employer's staff, supply of basic minimum spares for equipments.

Indian Type W.C:

General

The item pertains for providing white or colour glazed vitreous chinaware Indian type water closet of size and colour as specified in the schedule including fixing.

Squatting pans shall be of white vitreous china conforming to IS 2556 Part-I for General Requirements and relevant IS codes for each pattern as described below:

a) Long pattern-conforming to IS 2556 (Part-3).
b) Orissa pattern-conforming to IS 2556 (Part-3).
c) Integrated type conforming to IS 2556 (Part-14). Preferably Orissa type pan should be used. Each pan shall have an integral flushing rim of suitable type. It

shall also have an inlet or supply horn for connecting the flush pipes. The flushing rim and inlet shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise specified or ordered by the Engineer-in- Charge. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.I. trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia vent horn, where required by the Engineer-in-Charge.

European Pedestal type Water Closet

Providing and fixing white vitreous china pedestal type water closet (European type) with seat and lid, 10 liter low level white vitreous china flushing cistern & C.P. flush bend with fittings & C.I. brackets, 40 mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required.

For general requirement relating to terminology, materials, manufacture, glazing, defects, minimum thickness, tolerances, performance and methods of tests shall confirm to IS 2556 (Part 1). Wall mounted water closet shall be of one piece construction. Each wall mounted water closet shall be provided with fixing arrangement and shall have an integral flushing rim of suitable type. It shall have an inlet for connecting the flushing pipe of dimension confirming to IS 2556. The flushing rim may be box or open rim type or a combination of both. In case of box rim, adequate number of holes and slot be provided. The flushing rim and the inlet shall be of the self draining type and weep hole shall be provided at the flushing inlet of the wall mounted water closet.

The WC shall be provided with not less than two fixing holes to enable the WC to be securely installed to the wall using metallic corrosion resistant bolts and nuts and an independent concealed support frame. The support frame (metal hanger or carrier), depending on the design shall be securely attached to the building structural members so that no strain is transmitted to WC connector or any part of the plumbing system. Each wall mounted water closet shall have an integral trap and P type outlet confirming to IS 2556 (Part 16): 2002. Inside surface of water closet and trap shall be uniform and smooth in order to ensure an efficient flushing. The outlet if without serration shall be glazed and if same is with serration, may not be glazed.

Installation of Water Closet

Fixing chair bracket with bolts in concrete grout, bolts of 12mm Ø at a distance of 180mm ±5mm between two fixing bolts in the wall such that the height of front rim up to finished

floor should be 400mm. Fix the rag bolt with the help of sleeves and the outlet hole in the wall should be made as 135 mm ± 5mm.

Fit the seat cover on EWC

Put the outlet rubber gasket in the outlet to fit in waste outlet hole. Put poly sheet in between wall & EWC. Fit the EWC in the bolts (fitted inside wall) & tight the same & put chrome plated cap on the bolts.

Method of Measurement and payment

Payment for Extended wall mounting, Pedestal Type water closet shall be made on the basis of numbers by counting the number of EWC laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, scaffolding charges, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

Wash Basin :

1. Providing and fixing White Vitreous China Surgeon type wash basin of size 660x460 mm with a pair of 15 mm C.P. brass pillar taps with elbow including operated levers.

2. Providing and fixing wash basin with C.I. brackets, 15 mm diameter CP Brass single hole basin mixer of approved quality and make, including painting of fittings and brackets, cutting and making good the walls wherever required.

(a) White Vitreous China Wash basin size 550x400 mm with a 15 mm CP Brass single hole basin mixer

Installation of Wash Basin:

a. The cutout is made on the slab according to the size of the fixing area of Wash Basin.
b. If tap hole is required in Wash Basin, then fix the water tap in tap hole to connect the connection of Pillar tap with angle valve.
c. Place the Wash Basin on the slab and put sealant at the bottom of rim of Wash Basin to fix Wash Basin. Fit the waste hole coupling in waste outlet of Wash Basin.
d. Connect waste coupling to drain with beneath the marble/Slab through bottle tarp.
e. Connect Water tap with angle valve.

Washbasin Oval shape (T-2):

Providing and fixing white vitreous china Table top wash basin size - 610*460*140mm, installed above granite / marble counter with 15 mm C.P. brass basin pillar tap, 32mm C.P brass waste coupling of standard pattern, including 2 nos. angle valve with riser pipes, connectors, adopters, all fittings etc. cutting and making good the walls/slabs wherever required.

Installation Of Wash Basin:

Cut the marble / Slab for waste hole of Wash Basin to accommodate the outlet area at desired location where the Wash Basin is to be placed. Area of the hole should be made suitable for the bottle trap (100 mm Ø approx).

If tap hole is provided in Wash Basin, then fix the basin mixer tap in tap hole to connect the connection of tap with hot & cold connection angle valve

Fix the waste coupling and place Wash Basin on marble plate/slab. To fix put sealant between slab and Wash basin.

After fixing the Wash Basin on marble slab, connect to drain with bottle trap beneath the marble /slab. Connect cold & hot connection pipe of tap with cold & hot connection angle valve.

Method of Measurement and payment

Payment for Wash Basin shall be made on the basis of numbers arrived at by counting the number of Wash Basin laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, scaffolding, charges, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

Flat Back Large Urinals

Providing and fixing star white vitreous China flat back large urinals size - 375x390x590mm with self closing flush valve fittings, standard size C.P. brass flush pipe, spreaders with unions and clamps (all in C.P. brass) with waste fitting as per IS : 2556, and other couplings in C.P. brass, including all necessary fixings and fittings complete with painting of fittings and cutting and making good the walls and floors wherever required.

Installation of Urinals:

Mark the screw fixing position at top and bottom end on the wall such that the height of front rim should be at a distance of 700 mm from finished floor.

Make holes with drill on wall at marked position with drill bit of 5 mm diameter and insert PVC sleeve inside the holes.Fix the urinal on wall with screws. Connect the incoming water line on top & connect waste pipe on outlet.

Nos. of urinals in range	Capacity of flush tank	Size of C.P. brass Flush pipe	
		Main	Distribution
One	5 litres	15mm	15mm
Two	10 litres	20 mm	15 mm
Three	10 litres	25 mm	15 mm

Sinks:

Laboratory sinks and Kitchen sinks shall be of white glazed fire clay confirming to IS 771 (Part-2) with up to date amendments. The kitchen sink shall be of one piece construction with or without rim but without overflow.

1. Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink as per IS: 13983 with C.I. brackets and stainless steel plug 40 mm, including painting of fittings and brackets, cutting and making good the walls wherever required.Kitchen sink with drain board 510x1040 mm bowl depth 200 mm.

2. Providing and fixing white vitreous china laboratory sink with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P brass waste and 40mm C.P. brass trap with necessary C.P. brass unions complete, including painting of fittings and brackets, cutting and making good the wall wherever required.

a) Size 450x300x150 mm

b) Size 600x450x200 mm

Bottle Trap:

1. Providing and fixing CP Brass 32mm size Bottle Trap of approved quality & make and as per the direction of Engineer-in-charge.

2**.** Providing and fixing PTMT Bottle Trap for Wash basin and sink.

- Bottle trap 31mm single piece moulded with height of 270 mm, effective length of tail pipe 260 mm from the center of the waste coupling, 77 mm breadth with 25 mm minimum water seal, weighing not less than 260 gm.
- Bottle trap 38 mm single piece moulded with height of 270 mm, effective length of tail pipe 260 mm from the center of the waste coupling, 77 mm breadth with 25 mm minimum water seal, weighing not less than 263 gm.

C.P. Brass Sink Cock

Supplying, fixing testing and commissioning of C.P. Brass Sink cock With Extended Swivel Spout (Wall Mounted) type with all fixtures and fittings complete of approved quality conforming to IS standards.

A Sink Cock is a draw off tap with a horizontal inlet and free outlet with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be crutch type securely fixed to the spindle.

Installation of Sink Cock:

a. Place faucet and cover plate onto the wall mid of the sink and fix it with the screws.
b. Adjust faucet position as necessary, then tighten all mounting hardware.
c. Slip spray hose through flange and route hose up through faucet center mounting hole and slip washer supplied.
d. Apply teflon tape to supply tube and attach hose to threaded adapter on faucet.
e. Connect the supply hoses to the water supply.
f. Turn on water supply and check for leaks

Method of Measurement and payment

Payment for Sink Cock shall be made on the basis of numbers arrived at by counting the number of Sink Cock laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

Two Way Bib Cock

Supplying, fixing testing and commissioning of C.P.Brass two way bib cock with wall flange and aerator type with all fittings and fixtures complete of approved quality conforming to IS standards.

Method of Measurement and payment

Payment for Two way Bib cock shall be made on the basis of numbers arrived at by counting the number of Two way Bib cock laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

Health Faucet

Supply, fixing, testing and commissioning of Hand Shower (Health Faucet) near EWC consisting of 15mm dia C.P. Angle stop cock and 1mtrs. Long C.P. flexible tube with wall hook includes all fittings and fixtures i.e connectors, adopters etc. conforming to IS standards.

Method of Measurement and payment

Payment for Health Faucet shall be made on the basis of numbers arrived at by counting the number of Health Faucet laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

PTMT Brass Towel Ring

Providing and fixing PTMT towel ring trapezoidal shape 215 mm long, 200 mm wide with minimum distances of 37 mm from wall face with concealed fittings arrangement of approved quality and colour, weighing not less than 88 gm.

Method of Measurement and payment

Payment for PTMT Towel Ring shall be made on the basis of numbers arrived at by counting the number of PTMT Towel Ring laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

PTMT Towel Rail

Providing and fixing PTMT towel rail complete with brackets fixed to wooden cleats with PTMT brass screws with concealed fittings arrangement of approved quality and colour.

600 mm long towel rail with total length of 645 mm, width 78 mm and effective height of 88 mm, weighing not less than 190 gm.

Method of Measurement and payment

Payment for PTMT Brass Towel Rail shall be made on the basis of numbers arrived at by counting the number of PTMT Brass Towel Rail laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

Toilets for Disabled Persons (Full sets)

Providing and fixing of star white EWC and low level cistern of 6 liter capacity , angle valve with riser pipe with fittings and seat cover and including of wall hung compact washbasin of size 46x36cm fixed to wall with brackets, 1 nos.of angle valve with riser pipes, connectors, adopters, all fittings and one hinged rail of 76cm with one pair of mounting brackets and 5Nos grab rails of 60cm for support, faucet with spatula lever (without Bottle trap) with all fittings and fixtures complete, angle valve, riser / connector pipe, nuts, bolts, connector, adopter, check nuts etc including cutting and making good the walls and floors wherever required.

Method of Measurement and payment

Payment for Toilets for Disabled shall be made on the basis of numbers arrived at by counting the number of Toilets for Disabled laid in position. Rate shall include cost of all materials, labour charges, transportation, cost, scaffolding, charges, taxes, hire charges for tools and plants, finishing charges and curing etc. complete.

Floor Trap Grating

Supplying and fixing of Square (125x125mm) & Round Stainless Steel grating of SS-304 including GI hopper for connection of wash basin/ urinal with fittings, connectors &adopters. and all fittings etc., complete.

Method of Measurement and payment

Payment for floor trap grating can be made on the basis of number arrived at by counting the number of floor trap grating laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

Waste Fittings for Wash Basins and Sinks

The waste fittings shall be of nickel chromium plated brass, with thickness of plating not less than service grade 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall be sound, free from laps, blow holes and fittings and other manufacturing defects. External and internal surfaces shall be clean and smooth. They shall be neatly dressed and be truly machined so that the nut smoothly moves on the body.

Waste fitting for wash basins shall be of nominal size of 32 mm. Waste fittings for sinks shall be of nominal size 50 mm.

1. Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete.

a) Semi rigid pipe - 40 mm diameter

b) Flexible Pipe - 32 mm diameter

Mirror

General

The item providing bevelled or plain edges mirror with or without frame of size as mentioned in the schedule including fixing.

Material

The mirror shall be of superior glass with edges rounded off or beveled, as specified. It shall be free from flaws, specks or bubbles. The size of the mirror shall be 60 x 45 cm unless specified otherwise and its thickness shall not be less than 5.5 mm. It shall be uniformly silver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint. Where beveled edge mirrors of 5.5 mm thickness are not available, fancy looking mirrors with PVC beading/border or aluminium beading or stainless steel beading/border based on manufacture’s specifications be provided nothing extra shall be paid on this account. Backing of mirrors shall be provided with environmentally friendly material other than asbestos cement sheet.

Fixing

Mirror shall be fixed in position with 6mm thick marine ply wood backing. It shall be fixed by means of 4 nos. of CP brass screws & caps over rubber washers and rawl plug or as per the manufacturer's specification unless specified otherwise the longer side shall be fixed horizontally.

Floor Clean Out (FCO)

Supplying and fixing of Square (125x125mm) & Round Stainless Steel – SS 304 clean out cover and include GI hopper for connection of CI pipe with fittings, connectors & adopters and all fittings etc., complete.

Method of Measurement and payment

Payment for FCO can be made on the basis of number arrived at by counting the number of FCO laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

Wall Mounted Double Coat Hook

Providing and fixing wall mounted Double Coat hook on door complete.

3.8.R.O. TREATMENT SYSTEM:

Providing, fixing, testing and commissioning of R.O. plant 1000 ltrs. Per hour flow rate having capacity to treat the raw water having TDS 1200 ppm and not less than 40%. The treated water should have TDS less than 100 ppm and hardness less than 50 ppm. The operating voltage to 230 volt AC +/- 10% along with required capacity pump and solenoid valves, dry run protection of pump, automatic tank level control, inbuilt auto flush timer for periodic flushing of membranes, hydro pneumatic tank, over voltage and over current protection with switch mode power supply system complete in all respects.,

The Potable water is passed through high-pressure pump to the R.O. membranes where in concentration is reduced and then taken for further process.

The RO system comprises of R.O. membranes house din FRP pressure tubes. All interconnecting low-pressure pipe line sand high pressure pipe line shall be UPVCSCH40/ SCH 80pipelines. High-pressure pumps are provided for pumping of the water through the membranes. Necessary instrumentation is provided to monitor the operation of the system.

PROCESS SCHEME:

- Raw Water Storage Tank.
- Filter Feed Pump.
- Pressure Sand Filter.
- Activated Carbon Filter.
- Anti sealant Dose.
- Micron Cartridge Filters.

- High Pressure Pump.
- Reverse Osmosis Module.
- Product Water Storage Tank.

Method of Measurement and payment

Payment for RO Plant can be made on the basis of number arrived at by counting the number of RO Plant laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

3.9.WATER DISPENSER UNIT

Supplying, fixing and commissioning of potable unit of approved make & suitable model for Water Dispenser with purified normal hot and cold water outlets including all fittings and accessories complete.,

Polyethylene Water Storage Tanks

Material Polyethylene used for manufacture of tanks and manhole lids may be high density (HDPE), low density (LDPE) or linear low density (LLDPE) and shall conform to IS 10146. Polyethylene shall be compounded with carbon black so as to make the tank resistant to ultra violet rays from the sun. The percentage of carbon black content in polyethylene shall be 2.5 ± 0.5 percent and it shall be uniformly distributed. The materials used for the manufacture of tank, manhole lid and fittings shall be such that they neither contaminate the water nor impart any taste, colour, odour or toxicity to water.

Providing and placing on terrace (at all floor levels) polyethylene water storage tank, ISI : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.

CP Brass Bib Cock

The CP brass bib cock shall be conforming to IS: 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the bib cocks are normally fitted. The dimensions of body for Bib Cock shall be as per table given to IS: 8931. Each bib cock shall be legibly marked with the Manufacture’s name and trade mark.

CP Brass Long Body Bib Cock

The CP brass long body bib cock shall be conforming to IS standards. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the long body bib cocks are normally fitted. The weight of long body Bib Cock shall be less than 690 grams. Each bib cock shall be legibly marked with the Manufacture’s name and trade mark.

CP Brass Angle Value

A valve with the inlet and outlet at right angles to each other and is intended to facilitate servicing of water fittings or appliances. The CP brass angle valve shall be conforming to IS: 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the angle valves are normally fitted. The dimensions of body for angle valve shall be as per table given to IS: 8931. Each angle valve shall be legibly marked with the Manufacture's name and trade mark.

M.S. Stays and Clamps

The clamps shall be made from 1.5 mm thick M.S. flat of 32 mm width, bent to the required shape and size to fit tightly on the socket, when tightened with nuts & bolts. It shall be formed of two semicircular pieces with flanged ends on both sides with holes to fit in the screws, bolts and nuts 40 mm long. The stay shall be minimum one meter long of 10 mm diameter M.S. bar. One end of the stay shall be bent for embedding in the wall in cement concrete block of size 20 x 10 x 10 cm in 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The concrete shall be finished to match with the surrounding surface.

3.10. CUTTING CHASES IN MASONRY WALLS

Making Chases

Chases are made in the walls for housing G.I. Pipes etc.

I**. Cutting of chases in one brick thick and above load bearing walls** :

a) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.
b) The depths of vertical chases and horizontal chases shall not exceed one third and one sixth of the thickness of the masonry respectively.
c) When narrow stretches of masonry (or short lengths of walls) such as between doors and windows, cannot be avoided, they should not be pierced with openings for soil pipes or waste pipes or timber joints, etc. Where there is a possibility of load concentration, such narrow lengths of walls shall be checked for stresses and high strength bricks mortar or concrete walls provided, if required.
d) Horizontal chases when unavoidable should be located in the upper or lower one third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one meter in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.
e) Vertical chases should not be closer than 2 m in any stretch of a wall. These shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

f) Masonry directly above a recess, if under than 30 cm (Horizontal dimension) should be supported on lintel. Holes in masonry may be provided up to 30 cm width x 30 cm height without any lintel. In the case of circular holes in masonry, no lintel should be provided up to 40 cm in diameter.

Cutting of chases in half brick load bearing walls

No chase shall be permitted in a half brick load bearing wall and as such no recessed conduits and concealed pipes shall be provided in half brick thick load bearing walls.

Cutting of chases in half brick non-loading bearing walls

In case of non load bearing half brick walls services should be planned with the help of vertical chases. Horizontal chases should be provided only when unavoidable.

Cutting of chases in stone masonry walls

The provision (i) to (vi) under S.No. I are equally applicable to stone masonry walls also.

Note:

1. No inclined chase shall be permitted in brick masonry or stone masonry walls. In case inclined chases are unavoidable these shall be cut with written approval of the Engineer-in-Charge, and shall be repaired properly to his satisfaction. However, in half brick masonry wall, no inclined chase will be permitted.
2. Chases shall be made by chiseling out the masonry to proper line & depth. Any damage to the adjoining portion or to any other item shall be made good, as decided by the Engineer-in-Charge, for which no extra payment shall be made. All dismantled material shall be removed from site. CPWD specifications 2019.

CUTTING HOLES IN R.C.C. FLOORS (UPTO 15 × 15 CM)

Square holes of size as specified shall be cut in R.C.C. floor and roofs for passing drain pipe etc. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-in-Charge. All the dismantled material shall be removed from the site.

Cement Concrete

After insertion of drain pipe etc. the hole shall be repaired with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and the surface finished to match with the existing surface. The top and bottom shall be finished properly to make the joint leak proof. The specifications for cement concrete work and finishing etc. shall be the same as detailed under relevant sub-heads.

POLYVINYL CHLORIDE (PVC) PIPES AND FITTINGS

PVC (SWR) class pipes and fittings Type A and of Type B for soil and waste discharging system of pressure rating Max 6Kg/cm2 and conforming to IS 13592: 1992, shall be used. The pipes shall be supplied in nominal lengths of 2, 3, and 4 or 6 meters as per IS 14735, tolerance on specified lengths shall be +/-10mm. Any physical test requirements shall be as per IS13592-1992.

Handling

Because of their lightweight, there may be a tendency for the PVC pipes to be thrown much more. Reasonable care should be taken in handling and storage to prevent damage to the pipes. Contractor should hold the fullest responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be given adequate supports at all times.

Laying

The PVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be, as per the specifications and instructions of the Engineer. The minimum thickness of fittings shall be of 3.2 mm. The fittings shall be of injection- moulded type with solvent cement joint. The pipes and fittings shall be capable of withstanding sun's rays. PVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets / MS supports as detailed in the drawings and as per the instruction of the Engineer. The cost of drilling holes in RCC slab, floor, RCC/masonry retaining wall with the core cutting machine and making good the same with approved quality cement concrete etc. is at its own cost. If the pipes laid above the floor level (sunken level), it should be rigidly fixed with PCC bedding and levelled at every 1 meter intervals.

Jointing

The jointing of pipes to fittings shall be done as per the manufacturer's instructions / recommendations and as per the Engineer instruction.

The PVC pipes and fittings shall be joined with Solvent Cement and jointing shall be carried out as follows:

1. Cut the spigot end of the pipe square.
2. All burrs from the internal and external surfaces should be removed.
3. The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
4. Apply uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
5. Insert the pipe end into the socket of the fitting and push it in up to the mark.

Remove the excess solvent cement and hold the joint firmly in position for 30 seconds to dry. Gluing should be avoided in a rainy or foggy weather.

The other method of jointing shall be by rubber rings. The material of rubber ring should conform to IS 5382-1969.The ring is housed in groove formed in a plastic or metallic housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber 'O' rings are used, mineral oil or petrol or grease should be used.

Testing

PVC pipes and fittings shall be tested in accordance with IS 13592 - 1992. The openings of the pipes shall be sealed for the section to be tested. These are of non pressure pipe and testing carried out by gravity water pressure or smoke test.The water pressure of 0.5Mpa (1.5m of H**2**o or 0.15 kg/cm**2**) shall be maintained for a minimum period of 15 minutes and there should be no leakage at any joint. The Engineer shall examine carefully all the joints for leakage. The cost of equipment and accessories required for testing the system shall be supplied by the Contractor at his own cost.

Mode of Measurement PVC Pipes

PVC Pipes shall be measured along pipeline including the specials in running meter (Rm.)

The quoted rate shall include the following:

i) The cost of pipes, specials and other jointing materials.

ii) Laying, jointing and curing.

iii) Testing and making good the defects, if any.

CHLORINATED POLYVINYL CHLORIDE (CPVC) Pipes & Fittings

CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides.

Diameter and wall thickness of CPVC pipes are as per given below.

Pipe selected i.e SDR 11 up to 50 mm & above 50 mm schedule 40 or 80 as per design.

Sl. No.	*Nomi-nal Size*	*Nominal Outside Diameter*	*Mean Outside Diameter*		*Outside Diameter at any point*		*Class*
			Min	*Max*	*Min*	*Max*	*Avg. Max*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
(i)	15	15.9	15.8	16.0	15.8	16.0	2.2
(ii)	20	22.2	22.1	22.3	22.0	22.4	2.5
(iii)	25	28.6	28.5	28.7	28.4	28.8	3.1
(iv)	32	34.9	34.8	35.0	34.7	35.1	3.7
(v)	40	41.3	41.2	41.4	41.1	41.5	4.3

Notes

1. For CPVC pipes SDR is calculated by dividing the average outer diameter of the pipe in mm by the minimum wall thickness in mm. If the wall thickness calculated by this formula is less than 1.52 mm, it shall be increased to 1.52 mm. The SDR values shall be rounded to the nearest 0.5.

Dimensions of Pipes

The outside diameter, outside diameter at any point and wall thickness shall be as given in above table.

Diameter

The outside diameter and outside diameter at any point as given in above table shall be measured according to the method given in IS 12235 (part 1).

Diameter at any point

The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

(a) 0.5 mm, and

(b) 0.012 diameter rounded off to the next higher 0.1 mm.

Wall Thickness

The wall thickness of the pipes shall be as given in above table. Wall thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the conformity of the wall thickness of the pipe throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

Tolerance on Wall Thickness

a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness (eMin) and the wall thickness at any point (e), (e - eMin) shall be positive in the form of +y, where y=0.1 eMin+0.2 mm.
b) For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall thickness shall again be positive in the form of +y, where y would be applied in two parts.
c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values. The tolerance applied to this average wall thickness from these measurements shall be within the range 0.1 eMin+0.2 mm (see above table).
d) The maximum wall thickness at any point shall be within the range 0.15eMin (above table).
e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

Effective Length (Le)

If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

Pipe Ends

The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

3.11. PHYSICAL AND CHEMICAL CHARACTERISTICS

Visual Appearance:

The colour of the pipes shall be off-white. Slight variations in the appearance of the colour are permitted. The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

Capacity:

The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).

Effect on Water:

The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.

Reversion Test:

When tested by the method prescribed in IS 12235 (Part 5/ Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent.

Vicat Softening Temperature:

When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C.

Density:

When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m3 and 1650kg/m3.

Hydro-static Characteristics:

When subject to internal hydro-static pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The

temperatures, duration and hydro-static (hoop) stress for the test shall conform to the requirements given below table. The test shall be carried out not earlier than 24h after the pipes have been manufactured.

Sl. No.	Test	Test Temperature Min	Test Period
		°C	h
(1)	(2)	(3)	(4)
(i)	Acceptance	20	1
(ii)	Type	95	165

Thermal Stability by Hydro-static Pressure Testing:

When subject to internal hydro-static pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1) and as per requirement given above table, Sl. No. (iv), the pipe shall not burst or leak during the prescribed test duration.

Resistance to External Blow at 0°C :

When tested by the method prescribed in IS 4985, with classified striker mass and drop height as given in below table, the pipe shall have a true impact rate of not more than 10 per cent.

Sl. No.	Nominal Pipe Size	Mass of Fal Weight
	mm	Kg
(1)	(2)	(3)
(i)	15	0.5±0.5%
(ii)	20	0.5±0.5%
(iii)	25	0.5±0.5%
(iv)	32	0.5±0.5%
(v)	40	0.5±0.5%
(vi)	50	0.5±0.5%

Flattening Test :

When tested by the method prescribed in IS 12235 (part 19), pipe shall show no signs of cracking, splitting and breaking.

Tensile Strength :

When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 MPa at 27 ± 2°C.

Sampling and Criteria for Conformity

Each pipe shall be clearly and indelibly marked in ink/paint or hot embossed on white base at intervals of not more than 3 m. The marking shall show the following:

(a) Manufacturer's name or trade-mark

(b) Outside diameter,

(c) Class of pipe and pressure rating, and

(d) Bath or lot number

BIS Certification Marking: Each pipe may also be marked with the Standard Mark.

Fittings

The fittings shall be as follows:

a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
b) Brass threaded fittings.
c) Valve from size 15 mm to 160 mm
d) Brass Threaded Fittings: All types of one end brass threaded male/female adapter in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions.

All fittings shall carry the following information:

1. Manufacturer's name/trade mark.
2. Size of fitting

Piping Installation Support and Spacing

Concealed Piping: Pipes can be concealed in chases. The pipes and fitting are to be pressure tested prior to concealing the chases. To maintain alignment of CP fittings while joining, all alignment of fittings and pipe shall be done correctly. Do not use nails for holding of pipes in the chases.

External Installations: For pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes. Pipes sleeves shall be fixed at a place the pipe is passing through a wall or floor so as to allow freedom for expansion and contraction. Clamping of the pipe is done to support it while allowing the freedom for movement.

All pipes exposed to sunlight shall be painted with a water based acrylic paint emulsion to enhance UV protection. Pipes in trenching shall be laid in accordance to the Good Plumbing practices followed for Metal piping.

Pipe Size	Horizontal Support (In meters)			
	Temperature			
	23°C	38°C	60°C	82°C
16mm	1.22	1.22	1.07	0.92
20mm	1.53	1.37	1.22	0.92
25mm	1.68	1.53	1.37	0.92

Pipe Size	Horizontal Support (In meters)			
	Temperature			
	23°C	38°C	60°C	82°C
32mm	1.83	1.68	1.53	1.22
40mm	1.98	1.83	1.68	1.22
50mm	2.29	2.14	1.98	1.22
65mm	2.44	2.29	1.98	1.22
80mm	2.75	2.60	1.98	1.22
100mm	2.90	2.75	1.98	1.22

Expansion LOOP:

CPVC systems, like all piping materials, expand and contract with changes in temperatures. CPVC pipes shall expand 7.5 cm per 30 m length for a 400C temperature change.

Expansion does not vary with Pipe size. Thermal expansion can be generally be accommodated at changes in direction. On a long straight run, an offset or loop based on the following chart is required.

Nominal Pipe Size	*Length of Run (Meter), Loop I*		
	6 metre	*12 metre*	*18 metre*
15 mm	43	56	69
20 mm	48	66	81
25 mm	53	74	91
32 mm	58	81	102

Testing

All water supply systems shall be tested to hydro-static pressure test. The pressure tests are similar to the test pressure used for other plastic/metal pipes. System may be tested in sections and such section shall be entirely checked on completion of connection to the overhead tank or pumping system or mains.

Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a Rm(Running meter) for the finished work, which shall include CPVC pipe and fittings including plain and Brass threaded fittings and jointing solvent cement.

3.12. VALVES

Ball Valve (BRASS) (Up to 50mm size)

Supply and fixing in position the following lever operated, full flow, quarter turn, Ball Valves of Forged Brass body and chrome plated brass ball with chrome plated steel handle with PVC sleeve and PTFE seal tested to 25 Kg / Cm2 pressure rating, conforming to BS : 5159 manufacturing standards, including all unions and effecting proper connections.

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703. The ball valve shall be of following two classes:—

a. High Pressure: High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.
b. Low Pressure: Low Pressure float valves are indicated by the abbreviation 'LP' and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm.

Butterfly Valve (CI) (Above 50mm size)

Supply and fixing in position the following lever operated, full flow, Butterfly Valves of Cast Iron body, Ductile Iron Disc, with Nitrile integrally moulded rubber and pressure rating of Body- 10 Kg / Cm2 , Seat - 16 Kg / Cm2 conforming to IS :13095 manufacturing standards, including all unions and effective proper connections.

Butterfly valves shall be slim seal, short wafer type with standard finish. The valves shall be suitable for mounting between flanges drilled to ANSI 125. The valve body shall be cast iron. The disc shall consist of disc pivot and driving stem shall be in one piece centrally located. The disc shall move in bearings on both ends with 'O' ring to prevent leakage. The seat shall be moulded with black nitrile rubber or nylon and shall line the whole body. The spindle shall be AISI 41 steel. The valve shall be suitable for a working pressure of 16.5 kg/sq.cm and shall be complete with flow control lever and notches, factory machined companion flanges and bolts and nuts. These valves conform to BS 5155 with electro steel nickel coated SG Iron (N) and seat material EPDM3.

Also the following standard corresponds to their manufacture

Design	-	API609 / BS5155
Face to Face/ End to End Flange	-	ANSI B 16.10
Dimension	-	ANSI B 16.5
Butt Weld Ends	-	ANSI B 16.25
Pressure/Temperature Ratings	-	ANSI B 16.34
Seating	-	moulded in situ resilient lining of black Nitrile rubber
Body	-	Heavy duty CI to IS210 Gr FG220 & BS 1452 lining of black nitrile rubber.
Disk	-	Nylon coated SG iron of IS 1865 / SF400 / 127BS2729 Gr. 420 / 12

Shafts are to be made of SS AISI 431 Only, flanged valves to be used with Flanges drilled to BS10 table F, valves Shall be capable of being locked in open Position. Hand wheel shall be with Worm and worm wheel operated for Smooth opening and closing. Key rod with MS Coated extended spindle to be provided wherever the valves are not approachable from the ground surface.

Single Acting Air Valve / Ball Valve

Supply and fixing in position the following Single Acting Air Valve of large orifice type Cast iron body pressure rating of 10 Kg / Cm2 , 16 Kg / Cm2 conforming to IS 14845 : 2000 with lever operated, full flow, quarter turn, Ball Valves of Forged Brass body and chrome plated brass ball with chrome plated steel handle with PVC sleeve and PTFE seal tested to 25 Kg / Cm2 pressure rating, conforming to BS : 5159 manufacturing standards, and including all unions and effective proper connections.

Double Acting Air Valve W/ Ball Valve

Supply and fixing in position the following Double Acting Air Valve of large orifice type Cast iron body pressure rating of 10 Kg / Cm2 , 16 Kg / Cm2 conforming to IS 14845 : 2000 with lever operated, full flow, Butterfly Valves of Cast Iron body, Ductile Iron Disc, with Nitrile integrally moulded rubber and pressure rating of Body- 10 Kg / Cm2 , Seat - 16 Kg / Cm2 conforming to IS :13095 manufacturing standards, including fittings, GI flanges, connectors, adopters etc. all unions and effective proper connections.

Solenoid Valve

Supply and fixing in position the following Solenoid Valves with Brass body, SS-304 spring, pressure limit of 12 Kg / Cm2 and assembled with NBR seal, Include power cable, control cable, level probe/sensor/ electrode with all fitting & accessories complete set.

Solenoid Valves are compact, general-service, two-way guide type. They are available in brass with a normally closed design and can be oriented in any position. The solenoid enclosure provides protection against dust, while also protecting against seepage of oil and noncorrosive coolants. The Series SBSV- B valves come assembled with an NBR (Nitrile butadiene rubber seal, having a maximum process temperature of 176°F (80°C). The series offers a wide range of valve sizes and flow ranges, with connection sizes from 1/8″ to 2″ NPT and orifices from 3 mm to 50 mm. The material and make should be submitted to the Client/PMC. After approval, the make and material will be procured by the contractor.

Installation Of Valves

Valves should be installed in true tolerance of +/-5mm with respect to the center line of the pipe. Where threaded joints are encountered the threads should be initially sealed with PVC tape to avoid leakage due to improper tightening and leakage from threading.

Proper care has to be taken in welded installation so that the center line of valve should not deviate from the pipe causing uneven load on the pipe and further stress during its operation.

The welding should be done only after proper inspection of the joint by the Engineer in the tacked position of the joint.

Before putting the line in operative mode the valves should be checked for free and easy operation of the hand wheel. Any burrs or foreign materials should be removed by flushing before final operation so that no choking in the valves should occur which might damage the valve seat.

Method of Measurement and payment

Payment for valves can be made on the basis of number arrived at by counting the number of valves laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

3.13. PRESSURE REDUCING STATION

Supplying, fixing, testing & commissioning of Pressure reducing station includes brass Pressure reducing valve, 2 nos brass isolation valve, 1 nos strainer cast iron body with ss 304 basket strainer, 1 no cast iron non return valve, 15 mm SS 304 pressure gauge with ball valve 2 set complete with all fittings accessories, connectors, adopters etc complete. with pressure rating of 5 kg/sq.cm to 18 kg/sq.cm etc. the work shall also include accessories, etc, Complete..

Level Indicator

Supply and fixing in position the following Water Level Indicator with Tube connected to the tank at the side, pressure limit of 10 Kg / Cm2 and including all effective proper connections.

Water Meter (Bulk Type)

Supply, fixing, testing and commissioning of Multi Jet Water meter with Brass Body, Couplings, and Flow range varies from 0.12 to 15 cu.m/hr with pressure limit of 16kg/sq.cm. The output is perfect for remote monitoring of flow rate or flow totalization, and to be interface with PLC's, counters, data loggers, and SCADA systems complete with bolts, nuts, rubber insertions etc.

Water meters shall be selected according to flow to be measured and not necessarily to suit a certain size of main. The following points shall govern the selection of meters:

a) The maximum flow shall not exceed the nominal capacity of the meter.
b) The continuous flow shall be not greater than the continuous running capacity rating.
c) The minimum flow to be measured shall be within minimum starting flows.

Inferential water meter has the same accuracy as the semi-positive type at higher flows; it passes unfiltered water better than a semi-positive meter and is lower in cost.

Special care is necessary in selecting the most suitable meter where large rates of flow may exist for short periods. The normal working flow shall be well within the continuous running capacity specified in IS 779, as high rates of flow over short period may cause excessive wear if the meter chosen is too small for the duty.

Owing to the fine clearances in the working parts of meters, they are not suitable for measuring water containing sand or similar foreign matter, and in such cases a filter or dirt box of adequate effective area shall be fitted on the upstream side of the meter.

It shall be noted that the normal strainer fitted inside a meter is not a filter and does not prevent the entry of small particles, such as sand.

Water meters and their parts, especially parts coming in continuous contact with water shall be made of materials resistant to corrosion and shall be non-toxic and non-training. Use of dissimilar metals in contact under water shall be avoided as for possible in order to minimize electrolytic corrosion.

Body:

The body of water meter shall be made either from Type A or Type B materials as specified below:—

Type A: The body of water meters shall be made from bronze, brass or any other corrosion resistant material e.g. Grey iron castings, black heart malleable iron, periodical graphite iron casting.

Type B: The body of the water meters shall be made form suitable plastics.

Note: Plastics shall have following qualities:

1) It shall not affect the potability of water.
2) Elongation, 15 per cent, Min. on a specimen of length 150 mm (for procedure of determination of elongation).
3) Water absorption on immersion for 24 hours should not exceed 0.6 per cent by weight (for procedure of determination of water absorption).
4) It shall be capable of withstanding temperature up to 55°C without undergoing deformation or softening and becoming unsatisfactorily in performance.

Registration Box:

Registration box of water meters of Type A shall be made from bronze, brass, aluminium alloy or suitable plastics. Registration box of water meters of Type B shall be made from suitable plastics or aluminium alloys. The registration box of dry dial water meters shall be provided with one or two escape holes for minimizing the accumulation of condensed water.

Cap:

Cap of water meters of Type A shall be made from brass, bronze, aluminium alloy or suitable plastics. The cap of water meters of Type B shall be made of plastics or aluminium alloy. Where the cap and registration box are integral, the materials for cap may be the same as

used for registration box. The cap shall be so designed and fixed to the registration box as to avoid entry of water and dirt. The transparent window which covers the dial shall be inserted from the inside into the cap. The protective lid shall be secured by a robust hinge or other suitable method of robust construction.

Locking Arrangement:

Provision shall also be made to lock the lid. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be of a diameter not less than 4 mm.

Wiper:

Where so required for dry-type water meters the transparent window covering the dial shall be provided with a wiper on the inner side for wiping off condensed water.

Connecting Arrangements:

The meter casing shall be fitted in the pipe line by means of two conical or cylindrical nipples or tail pieces with connecting nuts which shall be provided with each meter. The nipples of water meters of Type A shall be made of the same materials as specified for body.

Nipples of water meters of Type B shall be made of the same materials as specified for the body where they are integral with the body of the water meters; where they are separate, they shall be made of malleable iron, galvanized steel or suitable plastics. The nuts shall be of the same material as used for nipples. The internal diameter of the nipple where it connects the pipe line shall be equal to that corresponding to the nominal size of the meter. The threads on the connection shall conform to IS 779. The minimum length of the threads shall be as given below table.

Overall Dimensions of Water Meters

Nominal size of Meter	*Overall length including nipples*	*Overall width. (Max.)*
1	*2*	*3*
15	250	100
20	290	130
25	380	170
40	430	210
50	470	270

Capacity on Short Period Rating or Nominal Capacity:

The nominal capacity of the water meters shall be as specified in above table. The meters shall be capable of giving minimum discharges as stated in the table without the head loss exceeding 10 m within the meters.

Yarn (Spun)

Spun yarn shall be of clean hemp and of good quality. It shall be soaked in hot coal tar or bitumen and cooled before use.

Method of Measurement and payment

Payment for water meter can be made on the basis of number arrived at by counting the number of water meter laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

G.I.SLOTTED BRACKET

Providing and fixing GI Slotted Brackets - up to 1500mm of approved design factory fabricated proprietary hot deep galvanized bracket supports including GI nut GI bolts, GI anchor fastener/bolt, GI washers etc complete to all pipe embedded and including cost of cutting holes and making good the walls etc.

Method of Measurement and payment

Payment for GI Slotted Brackets can be made on the basis of weight of bracket laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

RUBBER SHEET

Providing and laying Rubber Sheet of 6mm thick below polyethylene water storage tank

Method of Measurement and payment

Payment for Rubber sheet can be made on the basis area of rubber sheet laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

3.14. INSULATION FOR HOT WATER PIPES:

Providing and fixing insulation for hot water piping with elastometric Nitrile Rubber Tubular Insulation & the same insulation with aluminum cladding 22 gauge for hot water piping. Before applying insulation, all pipe work and fittings shall be brushed and cleaned. Dust, dirt, mortar and oil shall be removed.

Hot water pipes exposed in kitchen area must be provided with SS Jacket or Zinc aluminum jacket as per local code over the pipe insulation specified above.

The thickness of insulation to be applied shall be as follows:

Pipe Size	Insulation Thickness
15 mm, 20 mm	6 mm
25 mm, 32 mm	13 mm
40 mm & above	19 mm

Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work.

LAYING AND JOINTING G.I. PIPES (INTERNAL WORK)

For internal work the galvanized iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. When it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed in the ducts or recess etc., provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage and where so required joints are not buried. Where directed by the Engineer-in-Charge, a M.S. tube sleeve shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in walls or floors it should be painted with anti corrosive bitumastic paints of approved quality. The pipe shall not come in contact with lime mortar or lime concrete as the pipe is affected by time. Under the floors the pipes shall be laid in layer of sand filling as done under concrete floors.

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts, these clamps shall be embedded in brick work in cement mortar 1:3 (1 cement: 3 coarse sand), and shall be spaced at regular intervals in straight lengths as shown in the below table.

The clamps shall be fixed at shorter lengths near the fittings as directed by the Engineer-in-Charge.

For G.I. pipes 15 mm diameter, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Engineer-in-Charge. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) and properly finished to match the adjacent surface

Dia. of Pipe (mm)	Horizontal length (m)	Vertical length (m)
15	2	2.5
20	2.5	3
25	2.5	3
32	2.5	3
40	3	3.5
50	3	3.5
65	3.5	5
80	3.5	5

Unions will be provided to facilitate connections additions and alterations as well as for maintenance and for change of pipes. The locations where unions are to be provided will be decided with prior written approval of the Engineer-in-Charge.

3.15. MAKING CONNECTION OF G.I. DISTRIBUTION BRANCH WITH G.I. MAIN

Preliminary Work

A pit of suitable dimensions shall be dug at the point where the connection is to be made with the main and earth removed up to 15 cm below the main. The flow of water in the water main shall also be disconnected by closing the sluice or wheel valves on the mains.

Making Connection

For cutting and jointing 18.6.2 and 18.6.3 of CPWD Sepcification-2019 (Vol-2) shall apply. The G.I. main shall first be cut. Water if any collected in the pit shall be bailed out and, ends of the G.I. pipes threaded. The connection of distribution pipe shall then be made after fixing G.I. tee of the required size to the G.I. main and fittings such as Jam nut, G.I. socket connecting piece etc.

Testing of Joints

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra payment.

The pipes & fittings after they are laid shall be tested to hydraulic pressure of 6 kg./sq.cm. (60 m) The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock of water hammer. The draw of laps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

Finishing

The portion of the pipe in the pit shall be painted with bitumastic paint and encased with sand 15 cm all-round. The pit shall be filled with earth in level with the original ground surface watered, rammed and the area dressed.

Measurements

The work of making connections shall be enumerated.

Rate

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

S.W. Gully Trap:

Gully traps shall conform to IS 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free form crazing. They shall give a sharp clear tone when struck with light hammer.

There shall be no broken blisters. Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 Kg and the frame not less than 2.70 Kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

Fixing S.W. Gully Trap

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

(ii) **Fixing :**
The gully traps shall be fixed on cement concrete foundation 65 cm square and not less than 10 cm thick. The mix for the concrete will be 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size). The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes described above.

(iii) **Brick Masonry Chamber :**
After fixing and testing gully and branch drain, a brick masonry chamber 300 x 300 mm (inside) in brick work of specified class in cement mortar 1:4 (1 cement: 4 fine sand) shall be built with a half brick thick brick work round the gully trap from the top of the bed concrete up to ground level. The space between the chamber walls and the trap shall be filled in with cement concrete 1:5:10
(1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size).

The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement: 3 coarse sand), finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

C.I. cover with frame 300 × 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and rendered smooth. The finished top of cover shall be left about 4 cm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

(iv)Measurements:

The work shall be enumerated. Excavation shall be measured separately under relevant item of earth work.

(v) Rate: The rate shall include the cost of materials and labour involved in all the operations described above, except earth work which shall be paid for separately.

DROP CONNECTION (Sewer line connection with Manhole existing)

In cases where branch pipe sewer enters the manhole of main pipe sewer at a higher level than the main sewer, a drop connection shall be provided. The work shall be carried out as per Fig. 19.8. of CPWD Sepcification-2019 (Vol-2) S.C.I. pipes and special conforming to IS 1729 shall be of the same size as that of the branch pipe sewer.

For 150 and 250 mm main line, if the difference in level between the water line (peak flow level) and the invert level of the branch line is less than 60 cm, a drop connection may be provided with in the manhole by giving suitable ramp. If the difference in level is more than 60 cm, the drop shall be provided externally.

The main lines up to 350 mm diameter, are designed for half depth of flow, from 350 mm to 900 mm for 2/3 depth of flow and beyond 900 mm for 3/4 depth of flow.

Excavation

The excavation shall be done for the drop connection at the place where the branch line meets the manhole. The excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line.

Laying

At the end of branch sewer line S.C.I. cross shall be fixed to the line which shall be extended through the wall of the manhole by a horizontal piece of S.C.I. pipe to form an inspection or cleaning eye. The open end shall be provided with chain and lid. The S.C.I. drop pipe shall be connected to the cross at the top and to the S.C.I. bend at the bottom.

The bend shall be extended through the wall of the manhole by a piece of C.I. pipe which shall discharge into the channel. Necessary channel shall be made with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and finished smooth to connect the main channel. The joint between CPWD specifications 2019 1032 S.C.I. pipe and fittings shall be lead caulked as described in 18.5.3 of CPWD Sepcification-2019 (Vol-2). The joint between S.C.I. cross and S.W. branch line shall be made with cement mortar 1:1 (1 cement: 1 fine sand). The exposed portion of the drop connection shall be encased all-around with minimum 15 cm thick concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) and cured.

For encasing the concrete around the drop connection, the necessary centering and shuttering shall be provided. The holes made in the walls of the manhole shall be made good with brick work in cement mortar 1:4 (1 cement: 4 coarse sand) and plastered with cement mortar 1:3 (1 cement: 3 coarse sand) on the inside of the manhole wall. The excavated earth shall be back filled in the trench in level with the original ground level.

Measurements

Drop connection shall be enumerated. The depths beyond 60 cm shall be measured in running meter correct to a cm under relevant items.

Rate

The rate shall include the cost of labour and materials involved in all the operations described above but excluding the cost of excavations and refilling.

BOOSTER PUMP:

Providing, fixing, testing and commissioning of Booster pump. The speed of the pump is 2900rpm & rated flow is 2.4m³/hr and the rated head is up to 53.1m. the impeller and motor are made in Stainless Steel & pump with maximum operating pressure of 10Kg/sq.cm and power requirement of 0.9kW including all necessary fittings, valves, piping, labour etc to complete in all respects.

Method of Measurement and payment

Payment for Booster pump can be made on the basis of number arrived at by counting the number of Booster pump laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

Stainless steel Floor Trap 125mm diameter:

Supplying and fixing of Square & Round (125x125mm) approximately Stainless Steel grating with center hole 25mm diameter including GI hopper for connection of wash basin/ urinal with fittings, connectors & adopters. and all fittings etc., complete.

Method of Measurement and payment

Payment for SS Floor trap 125mm diameter can be made on the basis of number arrived at by counting the number of SS Floor trap laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

FLOOR GRATING:

Providing & fixing 150 mm wide & 600 mm long & 25 mm in height SS 304 channel grating with angle frame, grating square opening of 30 mm from 4 mm thick SS 304 flat. Angle

frame shall be suitable for 25 mm thick channel grating in SS 304 with hold fast at 1 meter interval on either side complete.

Measurements

Payment for Floor Grating can be made on the basis of number arrived at by counting the number of Floor Grating laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

FLOOR CLEAN OUT:

Floor Clean out : Providing and fixing of Stainless Steel floor clean out cover Square & Round (125x125mm) approximately plug with suitable for PVC pipes in Toilet areas including fittings, flanges, connector, GI rods GI coupling etc.

INSTALLATION METHOD:

The common toilet area should be connected to the soil and waste pipe using proper sealant or necessary solvent. Ensure the correct gradient of the soil pipe. In case of blockage, open the cover, insert the GI rod through the clean out to clear the blockage.

Measurements

Payment for Floor clean out can be made on the basis of number arrived at by counting the number of Floor clean out laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

Double Coat hook

Providing, Fixing wall mounted Stainless steel Double Coat hook on door complete.

Measurements

Payment for Double Coat Hook can be made on the basis of number arrived at by counting the number of Hook out laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

3.16. UNPLASTICISED POLYVINYL CHLORIDE PIPES AND FITTINGS

Providing and fixing PVC Pipes shall conform to Type A pipes of IS 14735. The internal and external surfaces of the pipes shall be smooth and clean and free from grooving and other defects. The end shall be clearly cut and shall be square with the axis of the pipe. The end may be chamfered on the plain sides. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible provided the wall thickness remains within the permissible limit.

Colour of Pipe

Surface colour of the pipes shall be dark shade of grey or as specified.

Marking

Each pipe shall be clearly and indelibly marked with the following information at intervals not more than 3 meters.

a) Manufacturer's name or trade mark.
b) Nominal outside diameter of pipe.
c) Type 'A'
d) Batch number.

Diameter and Wall Thickness:

Mean outside diameter, outside diameter at any point and wall thickness for type –A manufactured plain or with socket shall be as given in Table- 1 of IS 14735. UPVC rain water pipes shall be of the diameter, specified in the description of the item and shall be in nominal lengths of 2,3,4 or 6 meter either plain or with sliding/grooved socket unless shorter lengths are required at junctions with fittings. Tolerances on specified length shall be + 10 mm and – 0 mm.

Fixing and Jointing

Pipes shall be either fixed on face of wall or embedded in masonry as required in the description of the item. Plain pipes shall be secured to the walls at all joints with PVC Pipes clips by means of 50 x 50 x 50 mm hard wood plugs, screwed with M.S. screws of required length i/c cutting brick work and fixing in cement mortar 1:4 (1 cement : 4 coarse sand). The clips shall be kept about 25 mm clear off finished face of wall, so as to facilitate cleaning of pipes. Pipes shall be fixed perfectly vertical or to the lines as directed. The pipes shall be fitted to fittings with seal ring conforming to IS 5382 allowing 10 mm gap for thermal expansion.

Installation in Wall/Concrete

The walls/concrete slots should allow for a stress free installation. Pipes and fittings to be inserted into the slots without a cement base have to be applied first with a thin coat of PVC solvent cement followed by sprinkling of dry sand (medium size). Allow it to dry. The process gives a sound base for cement fixation. This process is repeated while joining PVC material to CI/AC materials.

Fittings

Fittings used shall be of the same make as that of the PVC pipes Injection moulded or fabricated by the manufacturer and shall have a minimum wall thickness of 3.2 mm. The fittings shall be supplied with grooved socketed ends with square grooves and provided with

Rubber Gasket conforming to IS 5382. The plain ends of the fittings should be chamfered. The fittings shall be joined with the help of Rubber lubricant. The details of fittings refer IS 13592.

Measurements

The fittings shall be measured by numbers. The pipes shall be measured net when fixed correct to a running meter Including all fittings along its length.

3.17. HIGH DENSITY POLYETHYLENE PIPES

Providing and Laying HDPE pipes & fittings as per IS 14333: 1996 with pressure rating of 6kg/sq.cm. This includes jointing of pipes & fittings as per standard design, refilling & testing of joints complete as per direction of Engineer-in-Charge.

	Test Results	**Acceptance Norms**	**Reference**
1	**Raw Material & Test Results**		
a)	Density Melt Flow	0.940 to 0.958G/CC	IS:4984:1995
b)	Rate(MFI)	0.2 to 1.1Mins.	IS:14333:1996
2	Visual Appearance		
a)	Surface finish	Satisfactory. The internal & external surface of the pipes are smooth and free from grooving & other defects.	IS:4984:1995 IS:14333:1996
a. b. c. d. e.	Dimensions & Tolerances Outside Diameter Wall Thickness, of Pipe Ovality Length: Pipe/ Coil	As per relevant BIS Standards	IS:4984:1995 IS:14333:1996
3	Performance Requirement		
a.	Heat Reversion	3% (Max.) Longitudinal Reversion	IS:4984:1995 IS:14333:1996
b.	Hydro-static Pressure Resistance Test	No failure or leakage during the specified period Acceptance Test: Duration 48 Hr sat 80° Cat specified stress value. Type Test: Duration 165 Hr sat 80° Cat specified Stress value.	
c.	Overall Migration Test	10Mg/dm2	
d.	Carbon Black Content	2.5+0.5%	
e.	Carbon Black	Satisfactory	

	Test Results	Acceptance Norms	Reference
	Dispersion		
f.	Density	940.0 to 958.0KG/M3	
g.	Melt low Rate	0.2 to 1.1Gms/10Mins	
4	**Identification Marking & Color**		
		Color: Black. A pipe is marked in white color by hot embossed or by indelible ink /paint by screening as mentioned below at every mater or on the either rend of pipes. Each Pipe has three equi-spaced longitudinal stripes in Blue color a)Manufacturer's Name b)Designation of Pipe c) Batch Number.	IS:4984:1995 IS:14333:1996

Wall Thickness of Pipe (All dimensions in mm)

Nominal	PN 2.5		PN-4		PN-6		PN-10	
Diameter	Min	Max	Min	Max	Min	Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
63	2.6	3.0	4.0	4.6	5.8	6.5	9.0	10.1
75	3.0	3.5	4.7	5.4	6.9	7.7	10.8	12.0
90	3.6	4.2	5.7	6.4	8.2	9.2	12.9	14.4
110	4.4	5.1	6.9	7.8	10.0	11.2	15.8	17.5
125	5.0	5.7	7.9	8.8	11.4	12.7	17.9	19.9
140	5.6	6.4	8.8	9.9	12.8	14.2	20.0	22.2
160	6.4	7.3	10.0	11.2	14.6	16.2	22.9	25.4
180	7.2	8.2	11.3	12.6	16.4	18.2	25.8	28.5
200	8.0	9.0	12.5	14.0	18.2	20.2	28.6	31.7
225	9.0	10.1	14.1	15.7	20.5	22.7	32.2	35.6
250	10.0	11.2	15.7	17.4	22.8	25.2	35.8	39.5
280	11.2	12.6	17.5	19.5	25.5	28.2	40.0	44.2
315	12.6	14.1	19.7	21.9	28.7	31.7	45.0	49.7
355	14.2	15.9	22.2	24.7	32.3	35.7	50.8	56.0
400	16.0	18.6	25.0	29.0	36.4	42.2		
450	18.0	20.9	28.2	32.6	41.0	47.3		
500	20.0	23.2	31.3	36.2	45.5	52.5		
560	22.4	26.0	35.0	40.5	51.0	58.8		
630	25.2	29.2	39.4	45.5				

Measurements

The net length of pipes as laid or fixed shall be measured in running meters correct to a cm for the finished work.

Gate Valve

Providing and fixing bronze gate valve with C.I. wheel of approved quality (screwed end) with unbreakable sheet metal hand wheel and Standards as per IS778 Class I complete with GI flanges, bolts, nuts, washers & rubber gaskets etc.

The primary function of a gate valve is for starting and stopping of flow. It has a disc actuated by a stem screw and hand wheel, moves up and down at right angles to the path of flow of fluid and seats against two faces to shut of flow. As the disc of the gate valve presents a flat surface to the direction of flow, this valve is only for starting and shutting the flow in the pipe.

Supplying, fixing and testing shall correspond to IS 778-1984, Specifications for Copper Alloy Gate valve.

All valves should have manufacturer's test certificate indicating the date of shop test and other quality control tests with the material used for the same. Gate valves shall be of the size as specified in the BOQ.

Method of Measurement and payment

Payment for gate valve can be made on the basis of number arrived at by counting the number of gate valve laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

Non-Return Valve (Gun Metal)

A non- return valve permits water to flow in one direction only and is provided on the ascending part of the main to check return flow. The non-return valve shall be of Gun metal and shall be of horizontal or vertical flow type as specified. The valve shall be of quality approved by The Engineer and shall generally conform to IS 778.

Sluice Valves

Providing and fixing C.I. sluice valves as per IS 14846: 2000 (with cap) complete with GI flanges, bolts, nuts, washers & rubber gaskets etc.

The supply of sluice valve should confirm to IS 14846-2000.

The sluice valve are provided as locations of branches and for permitting / stopping flow in the pipe line with the pressure rating of PN 1.0 and 1.6.

The sluice valve is either wheel operated or hand operated with size ranging from 50mm – 1200 mm diameter.

For mains up to 250mm, the sluice solvers are provided as per the main size. But for higher mains, to hare economy the valves sizes are reduced. The gear system arrangement is provided to make the valve operation easy. The sluice valves are manufactured is grey cast iron, FG 200, with spindle either made of bronze or stainless steel.

Proper gland packing, brushes, Nuts, Bolts etc are provided to prevent leakage through the sluice valve.

The flanged joints are made with rubber gasket6mm thick, holes made all round for joining of bolts and Nuts. The bolts should be fully threaded made of carbon steel classes 4.6.

Valve chamber

The sluice valve should be jointed to the pipe line with merged on either side and housed in on inspection chamber. The size of the inspection chamber is mention in DSR.

The chamber should be raised above the GL, at least 0.30mm above and covered with precast **RCC** slab with suitable opening for fixing the surface box.

The size of the surface box should be made of cast iron, with angle frame around fixed with a lid.

Coating

Coating material shall not import any tore and odour to water. It neither shall not contain any ingredients injurious to health, neither shall it be affected by water after drying nor shall it hare any ill **effects** on the quality of water. Two coats of black coat confirming to type B, of IS 341 or pair confirming to type 2 of IS 9862 shall be applied as specified by the purchaser.

Method of Measurement and payment

Payment for Sluice valve can be made on the basis of number arrived at by counting the number of sluice valve laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

3.18. AIR VALVES

Supply and fixing in position the following Single Acting Air Valve of large orifice type Cast iron body pressure rating of 10 Kg / Cm2 , 16 Kg / Cm2 conforming to IS 14845 : 2000 manufacturing standards, including all fittings, connectors, adopters, unions and effective proper connections etc. completer

The Indian standards covers requirement of single Air valve and Double air valve with or (without integral isolating valve) and kinetic air valves with or with our separate sluice valves for use on water mains.

a. **I. Single Air valve** (small orifice) - for automatically releasing air which may be accumulated under pressure is a section of pipe line during normal working condition

II. Single air valve (large orifice) - for automatically releasing / admitting air that may accumulated under pressure is a section of pipe line of the time of initial charging or draining of mains.

b. **Double air valves:**
These valves are combination of small / large orifices air valves with common connection to the main. Large orifice serves for automatically exhausting air when a pipe is being filled with water or automatically ventilating the pipe when it is being emptied of water.

End connection

1. End connection of single air value shall be either flanged according to IS 6418 or screwed. Screwed type shall have external pipe threads confirming to IS 554.
2. Double air valves shall have flange ends machined and drilled according to IS 1538 / Pr. IV & VI) of IS 6418.
3. For kinetic air valves, all flanges including that of the isolating sluice valves shall be marched and drilled in accordance with IS 1538 / pr IV & VI) flanges shall be as right angles to the axis of the inlet bore and also concentric to the bore. Flanged bolts shall be drilled off the center.

Materials

All the materials for the different components of the valves shall confirm to IS 14845 / 2000

Hydraulic Testing

Each valve shall be subjected to hydraulic tests to the test pressure and test duration as given below

PN Rating	test for / body / seat	Test pressure MPa
PN 1.0	Body Seat	1.5 1.0
PN 1.6	Body Seat	2.4 1.6

Method of Measurement and payment

Payment for Air valve can be made on the basis of number arrived at by counting the number of Air valve laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

SCOUR VALVES

Providing and fixing C.I. scour valves (with cap) complete with GI flanges, bolts, nuts, washers & rubber gaskets etc.

Scour valve is as arrangement made to drain off the water from the pipe line by providing a 'Scour Tee' and connected to the sluice valve with necessary flanged CI pipes, Duck flow bend and semi circular bend. The valves are manufactured is grey cast iron, FG 200, with spindle either made of bronze or stainless steel with the pressure rating of PN 1.0 and 1.6.

The scour valves are located at 120 lowest long profiles. So as to drain the water conveniently and also disposes the water away from the pipe line.

Scour valves are provided for attending repair / replacement of pipe, when the pipe is leaking or burst out.

The specifications stipulated for sluice valves shall be adhered for making scour arrangements.

The scour valve shall be designed or adopted as given below

Size of the scour - size of the main **Error! Reference source not found.** + 25mm

Method of Measurement and payment

Payment for Scour valve can be made on the basis of number arrived at by counting the number of Scour valve laid in position. Rate shall include for all materials, labour charges, transportation, scaffolding, all taxes, hire of tools and plants etc. complete for the finished work.

Unions

Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each Gunmetal Valve, Stop Cocks, or Check Valves and on straight runs as necessary at appropriate locations as required and/or directed by Engineer-in-Charge.

3.19. EXTERNAL SEWERAGE / DRAINAGE SYSTEM /BOREWELLS / PUMPS

Scope of Work

Work under this section shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely finish Sewerage/Drainage system as specified hereinafter or given in the approved drawings.

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

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

- Testing of pipe lines

General Requirements

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

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

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

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

All drainage work shall be done in accordance with the local Municipal bye-laws.

Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete 1:2:4 all round with the prior approval of the Engineer-in-Charge.

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

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

Alignment and Grade

The sewer pipes shall be laid to alignment and gradient shown on the approved drawings but subject to such modifications as shall be ordered by The Engineer from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Engineer-in-Charge.

STONEWARE PIPES

For all drains Crossing and required places, glazed stoneware pipes shall be used as far as possible in preference to other types of pipes. These are suitable, particularly where acid effluents or acid sub-soil conditions are likely to be encountered.

i) **Trenches:** Specifications described in 19.2.2.1 of CPWD Sepcification-2019 (Vol-2) shall apply, as far as possible. The trench shall be so dug that the pipe can be laid to the required alignment and at the required depth. When the pipe line is under a roadway, a minimum cover of 90 cm is recommended for adoption, but it may be modified to suit local conditions. The trench shall be excavated only so far in advance of pipe laying as specified by the Engineer-in-Charge. The trench shall be so shored and drained that the workmen may work therein safely and efficiently. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains.

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

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

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

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

(c) Notwithstanding (a) and (b) the total width of trench shall not be less than 75 cm for depths exceeding 90 cm. The width of trench in the upper reaches shall be increased as described in sub-head 'Earthwork'.

CEMENT CONCRETE PIPES (with and without Reinforcement) (Light Duty, Non-Pressure)

The pipes shall be with or without reinforcement as required and shall be of class not lesser than NP2. These shall conform to IS 458 and shall be capable of withstanding a test pressure of 0.07 MPa (7 m head). The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process while un -reinforced cement concrete pipes by spun or pressure process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete used for the manufacture of un-reinforced and reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm, the maximum size of aggregate should be 10mm. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydro-static pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

The minimum clear cover for reinforcement in pipes and collars shall be as given in Table 19.3.

TABLE 19.3

Sl. No.	Precast concrete pipe/collar	Minimum clear cover, mm
(i)	Barrel wall thickness	
(a)	Up to and including 75 mm	8
(b)	Over 75 mm	15
(ii)	At spigot steps	5
(iii)	At end of longitudinal	5

Note: An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of rust proof material or of steel protected against corrosion.

MANHOLES

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 30 m.

Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer - in-Charge. The size specified shall indicate the inside dimensions between brick faces of the manholes.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber. In exceptional cases and where unavoidable, the crown of the branch sewer may be fixed at lower level but in such cases the peak flow level of the two sewers shall be kept the same.

Sewers of unequal sectional area shall not be joined at the same invert in a manhole. The invert of the smaller sewer at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch sewers shall deliver sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

No drain from house fittings, e.g. trap or soil pipe, etc. to manhole shall normally exceed a length of 6 m unless it is unavoidable.

Manholes 90 × 80 cm are generally constructed within compound for house drainage only and near the buildings for house drainage. Manholes 1.2 m × 90 cm are generally constructed for main drainage work for depths less than 1.5 m. Manhole 1.4 m × 90 cm is of the arched type and is generally constructed for main drainage works where depth is 1.50 m or more. The width of manholes shall be increased more than 90 cm on bends or junctions or pipes with diameter greater than 450 mm and that the benching width on either side of the channel is minimum 20 cm.

Manholes 1.4 m internal diameter are generally constructed for main drainage works where depth is 2.45 m or more as an alternative to manholes of arch type. The diameter shall be increased suitably, for pipes with diameter greater than 450 mm in the same manner as in the case of rectangular manholes.

Before deciding size of manholes, Local Municipal Bye Laws shall be consulted. As a general guide some typical type designs of manholes followed in Delhi have been shown in Fig. 19.4 to 19.7. When manholes are constructed on foot path, these shall be provided with

cover of medium duty casting and when built within the width of the road under vehicular traffic, these shall be provided with cover of heavy duty casting.

All Manholes, Chambers, etc., shall be supported on base of cement concrete of such thickness and mix or shown on the approved shop drawings.

Where not specified, Manholes will be constructed as follows: -

(All dimensions internal clear in cm)

Size of Manhole Type	**90x80 Rect.**	**120x90 Rect.**	**910 dia. Circular**	**1220 dia. Circular**	**1520 dia. Circular**
Maximum depth	100	245	170	230	Any depth beyond 230
Average thickness of R.C.C slab	15	15	--	--	--
Size of cover and frame (Internal dia.)	61x45.5	50 dia.	56 dia.	56 dia.	56 dia.
Weight of cover and frame	38 Kg.	116 Kg.	116 Kg.	116 Kg.	116 Kg.
Type of Cover & Frame	SFRC	SFRC	SFRC	SFRC	SFRC

FOOT RESTS

All manholes deeper than 0.8 m shall be provided with M.S. foot rests. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:3:6 (1 cement: 3 coarse sand 6 graded stone aggregate 20 mm nominal size). The concrete block with M.S. foot rest placed in its center shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth.

TABLE 19.5

Sizes of drain (mm)	Top of channel at the center above bed concrete (cm)	Depth of benching at side walls above bed concrete (cm)
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

Foot rests which shall be of 20 × 20 Sq. M.S. bars as shown in Fig. 19.8 shall be fixed 40 cm

apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing.

Commissioning

After successful testing of the different sewerage and drainage pipes in parts, the Contractor shall provide all facilities including necessary piping's, labour, tools and equipment etc. for carrying out testing and commissioning of the entire external sewerage and drainage system complete as per requirement in the presence of Client representative/Consultant, wherever and as may be required. Generally, the following test/inspection has to be carried out:-

- For any Leakages/ seepage in the external sewerage and drainage pipes.
- For checking the functioning of the entire external sewerage and drainage system including rainwater harvesting system and to ensure that the waste water is continuously flowing towards outfall without any intermediate stagnation.
- For the functioning of the valves and accessories etc. by putting ON/OFF the controlling valves of the various diversions in the sewerage and drainage and rain water harvesting system.

UN PLASTICIZED RIGID PVC RAIN WATER PIPES FOR RAIN WATER HARVESTING SYSTEM

Rainwater Pipes

a) All terraces shall be drained by providing down-takes rainwater pipes.
b) A separate piped drainage system for slopping roof with ladders shall be provided.
c) Rainwater pipes are separate and independent connected to the external storm water drainage system.
d) Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water drains.
e) Any dry weather flow from waste appliances, AHU's pump rooms, shall be connected to the sewerage system only.

Low level terrace / Planter drainage

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

Pipes

- All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be conforming to I.S. 4985 class 3(6kg/cm2) for rain water.

- Pipes shall be joined by approved type of socket and 'O' rubber ring (confirms to I.S. 5382) joints with rubber lubricant.

Fittings

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

Fixing

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

Clamps

- Holder bat clamps shall be of standard design and fabricated from galvanized M.S. standard flats 40x3 mm thick and 12 mm diameter. M.S. Rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1:2:4 mix blocks 10x10x10 cm deep.
- Where holder bat clamps are to be fixed in RCC column or slotted angles, walls or beam they shall be fixed with galvanized 40x3 mm flat iron "U" type clamps with anchor fasteners of approved design or 6 mm nuts and bolts.
- Structural clamps shall be fabricated by electro welding from M.S. structural members e.g. rods, angles, channels flats. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes as required. Angles

/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.

- Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and making good with cement concrete 1:2:4 mix (1 cement :2 coarse sand :4 mm stone aggregate 20 mm nominal size) as directed by the Engineer-in-Charge.
- Providing and fixing to the inlet mouth of rain water pipe cast iron grating 15 cm diameter and weighing not less than 440 grams.
- For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

Clamp and Pipe Support Spacing

<table>
<tr><td></td><td></td><td colspan="7">< ---------Commercial Pipe Dia (Spacing in m)---------></td></tr>
<tr><td>S.No</td><td>Type of Pipes & Position</td><td>15/20</td><td>20/25</td><td>32/40</td><td>50</td><td>75/80</td><td>100/110</td><td>150/160</td></tr>
<tr><td>1</td><td>Vertical Pipes</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>1.1</td><td>GI / MS Pipes</td><td>2.4</td><td>2.4</td><td>3</td><td></td><td>3.6</td><td>4.5</td><td>5.4</td></tr>
<tr><td>1.2</td><td>UPVC Pipes Soil & Waste CI Pipes</td><td>x</td><td>x</td><td colspan="4"><----------1 m----------></td><td></td></tr>
<tr><td>1.3</td><td>UPVC/CPVC Pipes IS 4985 for Water Supply</td><td>x</td><td>x</td><td>x</td><td></td><td colspan="3"><----------1 m----------></td></tr>
<tr><td></td><td>IS 13585 for SWR</td><td>x</td><td>x</td><td>0.5</td><td></td><td>0.7</td><td>0.9</td><td>0.9</td></tr>
<tr><td>2</td><td>Horizontal Pipes</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2.1</td><td>GI/MS Pipes</td><td colspan="2" rowspan="2"><----2.0m----></td><td>2.4m</td><td>3</td><td>3.6</td><td>4</td><td>4.5</td></tr>
<tr><td rowspan="2">2.2</td><td rowspan="2">UPVC Pipes Soil & Waste Pipes IS Water Supply Pipes UPVC IS 4985</td><td colspan="4"><----------1.0 m----------></td><td></td></tr>
<tr><td colspan="2"></td><td colspan="3"><----------1 m----------></td></tr>
<tr><td>2.3</td><td>Fittings</td><td colspan="7">All traps and tees and fittings running below ceiling shall be supported on both sides</td></tr>
</table>

Khurras:

The khurras shall be constructed before the brick masonry work in parapet wall is taken up and it shall be of size 45 cm x 45 cm unless otherwise specified in the description of the item and shall be made of cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) or other mix as stipulated in the description of the item.

Laying:

A PVC sheet of size 1 m x 1 m x 400 micron (alternatively, aluminium foil of 32 SWG) shall be laid under the khurra and then cement concrete shall be laid over it to average thickness of 50 mm with its top surface lower than the level of adjoining roof surface by not less than 50 mm.

The concrete shall be laid to a size greater than the stipulated size of the khurra in such a way that the adjoining terracing shall overlap the concrete on its three edges by not less than 7.5 cm. The concrete will slope uniformly from the edges to the outlet, the slope being as much as possible and in no case less than 20 mm cement concrete at the outlet. The concrete shall be continued at the same slope through the width of the wall into the outlet opening to ensure a water tight joint.

The khurras and the sides of the outlet shall then be rendered with 12 mm coat of cement plaster 1:3 mix (1 cement : 3 coarse sand) or other mix as stipulated in the description of the item. This shall be done when the concrete is still green and shall be finished. The sides of the khurras and sides of the outlet opening shall be well rounded. The size of the finished outlet opening shall be 10 cm wide and by 20 cm high or as directed by the Engineer-in-Charge.

In cases where rain water is to be disposed off through rain water pipes, iron grating shall be provided at the outlet as a safeguard against choking, if so directed by the Engineer-in-Charge. Iron gratings, shall be of overall size 20 × 25 cm. with an outer frame of 15 × 3 mm M.S. flat to which 4 Nos M.S. bars of 10 mm diameter shall be welded in a vertical direction keeping equal clear spacing of 2.5 cm. or as directed by The Engineer .

Desalting Chamber & Rain Water Harvesting Tank

Rainwater harvesting is the collection of rainfall. In most cases, a roof is used for this purpose. The rainwater then flows through the Spouts / gutters, into a collection tank. The collected water can be used for small scale irrigation (of vegetable gardens etc.), clothes washing, bathing and after treatment also for drinking and food preparation.

A rooftop rainwater harvesting system consists the following elements:

(a) Collection area

(b) Conveyance/piping system,

(c) Filtration /treatment

(d) Storage

(e) Usage/ Recharge

The various components of systems for Rain Water Harvesting are covered in the CPWD Rain Water Harvesting and conservation Manual.

All Rainwater Collection Chamber shall be of the size 450cm, 300x100x450cm (internal) complete as per approved shop drawing or as instructions of Engineer-in-Charge.

Rain water harvesting pit is constructed preferably 5 to 10m from the permanent structure. The bore will be excavated manually or drilled by reverse direct rotary method up to the water level or as per instruction of Engineer-in-Charge.

The diameter of Rain water harvesting pit shall be 3000mm / 4500mm. Pit shall be filled with boulders, gravel and coarse sand.

Constructing brick masonry manhole (silt chamber type) inside size 1.20X0.90m, and 1.20m deep with FPS brick class designation 75 in cement mortar 1:4 (1 Cement: 4 coarse sand) 15mm thick RCC top slab with 500mm diameter opening in cement concrete 1:2:4 (1 cement: 2 C/sand: 4 graded stone aggregate, n/size reinforced with 18.92 kg cold twisted steel bars 20cm foundation concrete 1:4:8 (1 cement: 4 C/sand: 8 graded stone aggregate 40mm size) inside plastering 12 mm thick with cement mortar 1:3 (1 cement: 3 C/sand) finished with a floating coat of neat cement and providing 75 mm thick bed concrete in 1:2:4 mix (1 cement: 2 C/sand: 4 graded stone aggregate. 20mm n/size) including neat cement punning inside the manhole etc. all complete as per direction of Engineer-in-Charge.

Extra for depth for manhole size (120cmx90cm) with common burnt clay F.P.S (non modular) bricks of class designation 7.5

Bore shall be 450mm diameter and pipe shall be 250 mm UPVC (10 Kg/cm2) pipe. The pipe placed in the center of the shaft touching the lowest portion of the pit. The overflow pipe from the desalting chamber is directly connected to the rain water harvesting pit so that the rain water freely enters the pit for recharging. In addition to the inlet pipe from desalting chamber an overflow pipe at the ground level so that any excess water that enters the pit is automatically drained away without damaging the pit.

The Specifications for Storage tanks/Underground sumps shall be followed as per IS 2470: 1986 (Part I & II).

3.20. TUBE WELL (BORE WELL)

General Conditions

All work shall be done in a systematic manner in accordance with a programmer prepared in consultation with the Engineer-in-Charge.

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

Water Supply & Power

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

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

Site Clearance

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

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

Type of Well

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

Boring

Boring shall be 600-650 mm diameter to an approximate depth of 90-120 m. The depth may be increased or decreased as per actual site conditions. The depth at which the tube well boring is to be terminated shall be as agreed upon by The Engineer Sub-soil water shall not be tapped.

Well and Housing Pipes

Pipes shall be UPVC pressure pipe with couplings.

Slotted Pipes

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

Special Fittings

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

Verticality

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

Gravel Packing

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

Development

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

Water Tests

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

Sanitary Sealing

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

Bore Log

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

- Description and depth of strata
- Spring level below ground.
- Aquifer opposite which slotted pipes have been placed.
- Rate of progress of drilling
- Full particulars of final test
- Four copies of strata sheets yield and water quality tests shall be handed over on completion of the well.
- Suggested depth for the tube well submersible pump.

3.21. GARDEN HYDRANT SYSTEM

Scope of Work

The scope of this section comprise of the supply, installation testing and commissioning of piping network for garden hydrant & irrigation system.

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the garden irrigation system as required by the approved drawings, specified hereinafter and given in the approved drawing.

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

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

General Requirements

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

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

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

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

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

HDPE Pipes & Fittings

All pipes used in Garden Hydrant System shall be HDPE (High density Poly Ethylene pipe and conforming to I.S. 4984 of class IV (10 kg/sq cm)

Fittings shall be HDPE fittings, of approved make.

Pipes and fittings shall be jointed with butt welding joint.

Flanges

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

Trenches

The HDPE pipes and fittings shall be laid in trenches. The width and depth of the trenches for the different diameters of the pipes shall be as follows:

Dia. of Pipe	Width of Trench	Depth of Trench
15mm to 50mm	30 cms	60 cms
65mm to 100mm	45 cms	75 cms

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earth work in trenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

Pipe Protection

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

Lawn Hydrants:

Lawn hydrants shall be of 25mm size unless otherwise indicated. All hydrants shall be provided with gate valves and threaded nipple to receive hose pipes. Lawn hydrant valves shall be of approved make and design. Where called for lawn hydrants shall be located in masonry chambers of appropriate size.

Irrigation System (Pop up & Gun Sprinkler Irrigation System):

Gardens and lawns shall be irrigated in combination of Garden Hydrant System, Sprinkler Irrigation System & Rain Gun for Large Area. The Main Distribution grid shall be HDPE pipes PE-100 (10kg/cm2) conforming to IS: 4984 and branch distribution system be with UPVC pressure pipes (10 kg/cm2) confirming to IS: 4985. Irrigation water from STP shall be pumped to Irrigation Grid by a variable speed hydro pneumatic pumping system located at STP pump room.

¾" Gear Driven Pop Up Sprinkler:

SOLENOID ELECTRONIC CONTROL VALVE:

The valve shall have an operating pressure range of 1.0 -13.6 bars (15-200 psi). The valve body shall be manufactured of 33% glass reinforced nylon and be unaffected by climatic temperature variations within its full operating pressure range. The valve shall incorporate a straight through flow path design and be full ported to provide very high flow capacities at minimal friction loss. The valve shall meet / exceed the following flow characteristics at pressure losses not exceeding 0.5 bar (7.5psi): Size 2" Valve – 756 LPM [200 (US) GPM] with a minimum flow capability of 7.6 LPM (2.0 (US) GPM). The Valve shall be slow closing to avoid the potential for pressure surge/water hammer. The valve shall be normally closed and be either electrically or manually activated to open. The valve diaphragm shall be spherical, reversible and manufactured of durable reinforced Rubber. The valve diaphragm shall have a double seating surface for leak free closure. The valve manual operator shall be of an internal bleed design so as to provide no discharge of water to atmosphere. The valve manual operator shall be captive to the valve body assembly.

The valve flow control stem shall be constructed of stainless steel. All internal components, including the diaphragm shall be captive within the valve bonnet assembly. The valve shall utilize stainless steel screws and integrally molded brass inserts as body to bonnet fasteners. All valve control water shall be filtered through a conical stainless steel mesh screen. The valve shall incorporate not more than three internal components to minimize servicing. The valve shall have no hidden cavities so as to avoid potential for clogging. The valve should have pressure regulator to provide constant outlet pressure from 5 to 125 psi.

DISC FILTER: The disc filter shall confirm to following specification:

2" T TYPE DISC FILTER:

Available Connection:	2" (BSPT)
Closing system:	Stainless Steel Clamp
Max. Pressure :	8 kg/cm2
Range of Flow Rate:	22-35 m3 /hr
Nominal Flow Rate:	30 m3 /hr
Clean Pressure Drop:	Max 0.32 kg/cm2 at Nominal flow
Filtration Surface Area:	1193 cm2
Filtering Cartridge :	PP Disc (130 micron)
Cartridge Diameter:	117 mm
Cartridge length:	394 mm
Weight:	6.100 kg

PRO-Ex CONTROLLER:

PRO-Ex (6 Station) Controller shall be having multiple wire technology having 6 program with 6 starts time program. It has 6 available stations and run time per stations will be 0-10 hrs. 59 minutes max., and irrigation water budget by program 0-250% it has programmable rain of days 0-31 days max. and pause time between station will be 0-59 sec. It can run two valves plus master valve simultaneously. The controller should be capable to rain sensor and operate 100-230 VAC 50/60 Hz input power.

3.22. AIR RELEASE CUM VACCUM RELIEF VALVE:

It shall be of inlet size 2" of cast aluminum with synthetic rubber seal. It shall meet the requirement at working pressure 10 bar and testing pressure 16 bar.

PRESSURE RELIEF VALVE:

It shall be of inlet size 2" of cast aluminum with BSP female threaded connection. It shall meet the requirement at working pressure 10 bar and testing pressure 16 bar.

Handing Over Procedure

Documents Submission

The Contractor before finally handing over the completed work in his scope to the owner, shall submit the documents as per the Contract and as directed by the Engineer-in-Charge. Given below the checklist for the reference of the Engineer-in-Charge.

Packages/	Sanitary Fixtures	Soil, waste & vent pipes	Water supply system	Sewerage/ drainage system	Water tanks
Final cleaning					
List of inventory					
Training Conducted on					
Operation Manual					
Maine. Manual					
As built P&I Dwg / SLD					
Defects Liability Period/ Warranty					
Commissioning report					
Test reports/ Certificates					
List of essential spares					
Address/ Contact nos. of Vendors					
Remarks					

3.23. PUMP/WTP/STP/ETP/SOLAR HOT WATER SYSTEM

PUMBING SYSTEM

SCOPE OF WORK

The scope of work in this subhead shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely do all work relating to the supply, installation, testing & commissioning of Plumbing System as described herein after and shown on the drawings and Bill of quantities.

The scope of work in general shall included the following.

i. Water supply Pumps.
ii. Drainage Pumps
iii. Sewage Pumps
iv. Solar Booster Pumps
v. The WTP - Pumps.
vi. The STP Pumps

EXECUTION OF WORK

The Contractor shall cooperate with all services and agencies working on the site. Provisions for hangers, sleeves, structural openings, and other necessary requirements shall be made well in advance to avoid any delays in the construction schedule. All supports to the civil structure shall be provided using dash fasteners.

PREPARATION OF SHOP DRAWINGS

- The tender drawings and schematics of the WTP, RO, ETP, STP, and Solar Hot Water System are provided to the Contractor. Based on these, all detailed shop drawings shall be prepared and submitted to The Engineer for approval. The execution of the work shall be carried out in accordance with the approved shop drawings.
- The Contractor shall verify all dimensions at site and bring to the notice of The Engineer all discrepancies or deviations noticed. Decision of The Engineer shall be final.
- All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings to be submitted by the Contractor in fulfillment of the conditions of this contract.
- Shop drawings shall be furnished for detailed layout of all equipment, foundation, bolting and vibration elimination details along with information on dead and dynamic load, vibration etc.
- Two sets of manufacturer's equipment drawings, roughing in and wiring diagrams shall be submitted.
- Contractor shall submit shop drawings furnishing all details of MCC panels, cable routes, wiring diagrams and connection details as required.
- Each submission shall be accompanied by Contractor's certificate stating that the shop drawings meet all the contract requirements and that the piping and equipment can be satisfactorily installed without any obstructions in the space available.
- On approval of the above the Contractor shall furnish three sets of the approved shop drawings for execution of the work.

Inspection And Testing Of Materials

- Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Bureau of Indian Standards.
- For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary but not limited to the following: a) Steel tapes b) Weighing machine c) Plumb bobs, spirit levels,

hammer d) Micrometers e) Hydraulic machine

- All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-In-Charge. All testing equipment shall be preferably located in special room meant for the purpose.
- Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Engineer-In-Charge.

Completion Drawings

- On completion of work, Contractor shall submit one complete set of original tracings and four prints of "as built" drawings to The Engineer . These drawings shall have the following information.
  a) Run of all piping, diameters on all floors, vertical stacks and location of external services.
  b) Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.
  c) Run of all water supply lines with diameters, locations of control valves, access panels.
  d) Location of all mechanical equipment with layout and piping connections and mechanical equipment.
  e) All shop drawings shall be updated from time to time for the purpose of making completion drawings. No completion certificate shall be issued unless the above drawings are submitted.
- Contractor shall provide four sets of catalogues, service/operation & maintenance manuals, manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
- All "warranty cards" given by the manufacturers shall be handed over to the Engineer-In-Charge.

Testing

- Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.
- Tests shall be performed in presence of The Engineer and test records for the tests shall be duly signed by Contractor and the Engineer-In-Charge.
- All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.
- Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.
- Contractor shall provide all labour, equipment and materials for the performance of the tests.

3.24. PUMPS

Hydro pneumatic System for Multiple Overhead tanks filling

The scope shall cover the supply, installation, testing, commissioning of the Variable Speed Hydro pneumatic system (Individual VFD for Each Pump). Booster should minimum consist of the components as per the below specifications. Complete system shall be tested at the manufacturer's factory, in accordance to the provisions of the appropriate standard before delivery. Manufacturer should have facility of witness test with proper test bed.

System Descriptions

The variable speed booster system shall be supplied and installed as designed.

The system shall comprise of number of pumps as mentioned in BOQ, in parallel and it shall be a package system manufactured by the manufacturer of the pumps at their factory. System assembled by the dealers locally will not be accepted. System should come with CED coated base frame & Manifolds to reduce the rust formation. The system shall consist of:

Vertical In Line Multistage Centrifugal pumps with IE5 efficiency class Motor as per IEC 60034-30-2 standard. Pump should come with integrated VFD & Control panel with each pump.

The quantity shall be as per BOQ.

Integrated Frequency Drives with each pump (IP 55 Protected) Quantity shall be as per BOQ.

Low Carbon steel Pre-pressurized bladder or diaphragm type pressure vessel complete with pre-charged nitrogen gas/Air to the design pressure settings.

Each pump shall have individual PI controller & integrated VFD and with IE5 efficiency class motor as per IEC standard.

Pipe work and valves, pressure transmitter, pressure gauge, check valve, gate valve and all necessary fittings etc to the satisfactory operation of the system and to make system as complete. Only supply & delivery line will be connected to start the system

Components of Variable Speed Booster - Pumps and Motors

The pump shall be of approved make of vertical-in-line multistage centrifugal type pump with IE5 efficiency class motor, integrated VFD & controller with each pump with IP 55 protection.

The suction and discharge port shall be in line with each other. The maximum operating liquid temperature for the pump shall be up to 120 deg C.

The motors shall be vertically stool mounted on top of the pump casing and the pump casing

shall be designed to take the dynamic load of the motor. The motor shall be provided with thrust bearing to cater for the downward thrust of the pump.

The manufacturer of the pump should have a local factory with at least 20 years of experience and able to provide after sales service. The factory must have a pump testing facilities with approved test bed to carry out pump as well as complete booster performance witness testing.

Pump Selection

Each pump shall have the stable characteristics and the operating point shall fall within the acceptable range on the pump curve. Duty point should not be selected at extreme right or left side of the curve.

The pump performance curve shall be complying with the tolerance according to ISO 9906:2012, 3B. Per Pump

Pump Head and Base

Pump head and base should be made of CED (Cathodic Electro deposit) coated Cast Iron, SS-316 or better -Shaft, SS-304 Impeller, Mechanical Seal (SiC vs SiC face combination).

The motor terminal housing shall be of a completely watertight design with tight cable glands to prevent ingress of water. For bigger motor, the housing shall have provision for the lubrication of the motor bearing to enable the pump to run effectively with only periodic withdrawal for maintenance and lubrication, if required.

Shaft, Impeller and Guide Vanes

All the inter stage components (impeller, intermediate chambers, diffusers) as well as sleeves and guide vanes shall be made of stainless steel 304 material, Shaft-SS 316 or Better.

Mechanical Seal

The mechanical shaft seal shall be of cartridges type with seal faces of Silicon Carbide/silicon carbide material or C vs SiC. It should be possible to change mechanical seal without opening the pump to reduce downtime.

Motor

The electric motor shall be of total enclosed fan cooled (TEFC) squirrel cage induction type suitable for operation on a 380-500V / 3 Ph/ 50 Hz voltage supply. The motor shall be designed based on 50 deg C ambient temperature with IE5 Efficiency Class and integrated VFD & Controller (IP 55 Protection). The motor shall be of class F insulation and a minimum of IP 55 enclosure with a maximum surface temperature of 120 deg C.

The motor shall comply with the Efficiency Class IE5requirement as per IEC standard.

All motors shall be sized for pump operation based on non-overloading conditions for the full QH curve. The motor shall also be suitable for at least 40 start/stop per hour. All motor should be of IE5 efficiency class.

Variable Frequency Drives

Integrated AC variable (IP 55 Protection) drive with in-built Harmonics IEC/EN 61000-3-12.Up to 7.5 kW (5.5 kW low speed): Category C1 according to EN 61800-3, corresponding to CISPR11, class B (residential area) Above 7.5 kW (5.5 kW low speed): Category C3 according to EN 61800-3, corresponding to CISPR 11, class.

Pump Controller

Each Pump shall be having PI controller with HMI Graphical display. Controller should of the same make, as of pump i.e. Pump manufacturer should provide dedicated PI integrated controller with each pump for this application. General purpose PLC programmed for boosting application will not be accepted.

The controller should have the following features as minimum:

- Built-in PI-controller.
- External input signal both digital and analog. Alarm output.
- Soft pressure buildup.
- Colour Graphical Display.
- Suitable for Modbus (RS 485). Eternal BUS communication port. Automatic pump changeover.
- Upgradeable software program.
- Back light for specific button to be light up only when applicable. Adjustable contrast for display.
- Selectable service language. Selectable units between SI and US. Manual entry of pumps data.
- Primary sensors.
- Clock Program.

The controller should be able to perform the following functions as minimum: Selectable auto/manual mode for both system and individual pump from Controller

- Set point influence
- Friction loss compensation at lower flows.
- Adjustable number of start/stop
- Adjustable system time and error correction value
- Adjustable ON/OFF band (stop function)
- Pump test function
- Security setting with pass word for operation and setting
- External fault input

- Selectable dry running protection for either digital or analog signal
- Selectable auto/manual reset for dry running protection
- Selectable open/close loop operation
- The controller should be able to display the following alarms, whenever it occurs:
- Alarm log up to 24 event

Pump Selector Mode

Selection should be provided to enable any pump to be the lead pump, first duty pump, second duty pump and standby pump as desired. There shall be alternating mode selection too, where all pumps are operated cyclically upon each call for pumping.

Liquid Level Control

To prevent dry running, electrode liquid level or float level control shall be provided in the suction tank to shut down the system in the event of low water level.

Pump Isolation

It shall be possible to isolate any pump for maintenance without affecting the performance of the system in the automatic mode.

Alarm

Alarm should be displayed in case of any problem. Alarms should be as per details given in Panel section.

All panels/controllers shall be tested at the factory according to the procedures stipulated, before dispatch. The manufacturer shall carry all spare-parts for the controllers. All spares of the controllers shall be readily available for a minimum period of 10 years after the production of the particular model of controller has been discontinued.

Hydro Pneumatic Pressure Tank

The hydro-pneumatic tank shall be of butyl bladder diaphragm type with pre-pressurized air/nitrogen. It shall be capable of handling the designed effective system protection (ESP) Volume to protect pump and operating controls by ensuring that the actual pump operation conform to the manufacturer's specified minimum running time and maintaining the designed pressure range.

The shell shall be constructed with deep-drawn low carbon steel.

The diaphragm/membrane shall be of heavy-duty type. This diaphragm/membrane should be the only component in contact with the liquid.

The tank should have an air valve for the introduction of compressed air.

The tank shall have a maximum operating pressure of 10 bars/16 Bar depending on the pump shutoff head and shall be able to handle a maximum liquid temperature of 90 Deg C/70 Deg C respectively.

Pressure Transmitter

Pressure transmitters shall be field mounted and shall transmit an isolated 4-20mA signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have stainless steel wetted parts and it should be installed at the discharge header. It should have watertight, electrical enclosure capable of withstanding minimum 10/16 bar static pressure.

Headers, Skid & Accessories

The suction and discharge manifolds & skid shall be fabricated steel with Cathodic Electrode Deposit Coated. Both manifolds shall be designed to attach to the system piping at either end of the manifold (Completely Factory Assembled set, locally manufactured/assembled set is not acceptable). Delivery manifold shall include a pressure gauge along with 2 Nos of pressure transmitter. The discharge manifold shall include a socket to install a pressure transducer with a 4-20mA output. The pressure transducer shall be factory installed and wired.

Isolation valves shall be installed on the suction and discharge of each pump. A check valve shall be installed on the discharge of each pump (optional on the suction side for suction lift applications). Base frame should also be made of galvanized sheet.

Hydro pneumatic System Working

The system shall be under the control of PI based pump logic controller with graphical colour display. 2 Nos. of pressure transmitter shall be incorporated into the system to detect the pressure at the discharge manifold and feedback to the Microprocessor based controller.

The system shall maintain a constant pressure at all times regardless of the system demand. The activation of the next duty pump in a high demand situation shall not base on a different set point. However, the microprocessor based controller should have a flow test function to determine the numbers of pumps in operation and a stop function into the controller to stop all pumps from operation, whenever there is no demand, which prevent and reduce wear and tear of the system as well as reduce energy consumption. The controller shall also ensure alternation of all pumps for even running hours.

The lead pump shall operate when the system pressure reduces to the preset point. If demand escalates, the lag pumps shall commence operation as required. During next operation lead pump to become lag and lag pump to become lead pump automatically. The system shall vary the frequency of each pump (in case of multi VFD system) and it will be equalized to ensure smooth operation to meet the specific demand. Under decreasing hydraulic demand, the reverse to the above description shall apply

Operations

- The control circuit shall enable automatic and manual operations of the system.
- Automatic Operation
- Everything will be controlled by controller in this case.
- Manual Operation
- Either one or all pumps shall be capable of being started and stopped by their respective push buttons or MCB's.
- The control panel should have starters for this purpose

3.25. WASTE WATER PUMP

Drainage Pump

Supply installation & Commissioning of submersible drainage pump (1W+1S) for each sump with 3 Ph 380-415V 2 Pole Motor with CI or SS 304-Casing, SS 304 or DI/CI -Impeller, SS 304/SS 410- Shaft, Mechanical Seal suitable for handling 10-12mm soft solid**.**

Sewage Pump

Supply installation & Commissioning of submersible drainage pump (1W+1S) for each sump with 3 Ph 380-415V 2 Pole Motor with CI -Casing, DI/CI -Impeller, SS 304/SS 410-Shaft, Mechanical Seal suitable for handling 65mm soft solid or pump shall be with grinder system as per the requirement given in the BOQ**.**

Drainage/Sewage Pump Control Panel

Pump controller shall be having with screen displays, phase loss protection (incoming as well as for outgoing), Individual pump overload protection, individual pump under voltage protection, dry Running protection without installing any float switch, memory function when power off and during

Recovery, visual and audio alarm for fault prompt, auto manual switch, suitable for RS 485 Communication (ModBUS) depending on the site requirement and pump should operate based on The sump water level and both pump should run together for high level in case of more than one Pump. Panel should come with 3 Nos Float switch to work as per the sump water level.

Submersible Bore Well Pump

Supply installation & Commissioning of submersible bore well pump with SS 304-Casing/Impeller/Shaft & Mechanical seal coupled with a 380-415V, 50Hz 2 Pole, Insulation Class-F, IP 68 Protected Rewindable Electric Motor (Motor Make-.TESLA/FRANKLIN/GRUNDFOS BRAND). Pump hydraulic efficiency should not be less

than 75%. Pump controller suitable for 1 Pump with LCD screen displays, phase loss protection (incoming as well as for outgoing), Individual pump overload protection, individual pump under voltage protection, dry running protection without installing any float switch, memory function when power off and during recovery, visual and audio alarm for fault prompt, auto manual switch, and pump should operate based on the UGT water level. (For Bore well).Pump Control Panel. **Flow Rate Per Pump-16m3/hr, Head-41m, HP/Load 6.0 (Approx).**

Pump controller suitable for 1 Pump with LCD screen displays, phase loss protection (incoming as well as for outgoing), Individual pump overload protection, individual pump under voltage protection, dry running protection without installing any float switch, memory function when power off and during recovery, visual and audio alarm for fault prompt, auto manual switch, and pump should operate based on the UGT water level.

Pipe & Fittings (for Headers and Connections)

Pump suction and delivery headers shall be Galvanized iron pipes/MS heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer's instructions.

Vibration Eliminators All suction and delivery lines as shown on the drawings shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

3.26. VALVES

Sluice valves

i. Full way Sluice Valves shall be used on the suction connection to pumps and headers.

ii. Sluice valves (80 mm dia. and above) shall be C.I. double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.

iii. Sluice valves shall be of approved makes conforming to I.S.780 PN1.6 class.

Butterfly Valves (PN 1.6 rating)

i. Butterfly Valves shall be used in all other locations as required conforming to IS 13095.PN 1.6

ii. They shall have a cast iron body.

iii. Disc shall be CI heavy duty electrolysis nickel plated abrasion resistant.

iv. The shaft to be EN-8 Carbon Steel with low friction nylon bearings.

v. The seat shall be drop tight constructed by bonding resilient elastomer inside a

rigid backing.

vi. Built in flanged rubber seals. vii. Actuator to level operated for valves above ground and T Key operated for valves below Ground. viii. Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and Installation will be followed.

Non Return Valves (NRV PN 1.6 rating)

i. Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

ii. NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges. Valves shall conform relevant IS or match the butterfly valves.PN 1.6

iii. Built in flanges for screwed on flanged connections.

Ball Valves

Ball Valves up to 40 mm dia. shall be screwed type ball valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm2 and accompanying coupling and steel handles to B.S. 5351.

'Y' Strainers (PN 1.6 rating) Provide cast iron 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pump.

Painting and Cleanup

a) On completion of the installation Contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.

b) Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.

c) Provide painted identification legend and direction arrows on all equipment and piping as directed by Engineer-in-Charge.

d) On final completion of the work, Contractor should cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

3.27. CABLES

- Contractor shall provide all power and control cables from the motor control center to various motors, level controllers and other control devices.
- XLPE Cables shall be provided conforming to I.S. 7098.
- Wiring cables shall conform to IS 694.
- All power and wiring cables shall be aluminum conductor PVC insulated armoured and XLPE sheathed of 1100 volts grade.

- All control cables shall be copper conductor PVC insulated armoured and XLPE sheathed 1100 volts grade.
- All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.
- All cable joints shall be made in an approved manner as per standard practice.

Earthing

All equipment installed by the Contractor shall be suitably earthed by making proper connection by means of G.I. Wires to the main earthing system laid by the electrical Contractors.

3.28. WATER SUPPLY, FLUSHING / IRRIGATION SUPPLY PUMPS & EQUIPMENT

General Requirements

- All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-In-Charge.
- All equipment shall be of the best available make manufactured by reputed firms.
- All equipment shall be installed on suitable foundations true to level and in a neat workmanlike manner.
- Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
- Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
- Each pumping set shall be provided with a butterfly valve on the suction and delivery side and a flap type non return valve on the delivery side
- All pump couplings and belt guards for air compressors shall be totally enclosed with 5 mm mesh.

3.29. SYSTEM OF WATER SUPPLY

- The water supplied by the authorities will be stored in the domestic U.G. tank.
- Water from this U.G. tank shall be pumped to O.H. Tanks at terrace of each building by separate pumps/sump.
- Each toilet, bath, wash basin, sink and labs shall be fed with water from terrace tanks by gravity. Top three floors of the Hospital Building will be fed by Hydro pneumatic System.

Rising Mains & Level Control System.

- Water from the pumps described above will fill each tank by a rising main to each tower.

- To control the level in each tank and enable it to fill as the water demand so requires, each tank will be provided with a ball cock to shut off the water supply when the tank is full.
- A set of electronic level sensing probes will be installed in each tank The probes installed in each pumping system will be wired to a central electronic panel which will activate the pump when any one of the tank probe signals low water conditions and top up all tanks. No excess flow will occur due to the ball cock in the tank.

Level Controllers

- Level controllers shall be electronic magnetic type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications:-
- Provide a audible high water alarm when water level in the sump reaches a pre-determined high level in the sump location at MCC panel installed in wall near sump location

Overhead tank level controller cum indicators

- Each OHT to be provided with required number of stainless steel electronically operated probes (housed in a stainless steel protective housing) and connected by a control cable to a central junction box connected to MCC panel located in the pump house at basement. A common multi-core cable from each group of buildings will be laid to the pump room in basement. The probes will function as follows:
- To cut off the water supply pumps when all the OHT is full and to start the pump if any OHT level reaches at pre-determined low level.
- Provision shall be made to enable the operation of the second duty pump in case the water level does not rise above a pre-determined level in the tank due to water demand which is higher than capacity of duty pump no.1 to meet.
- Indicate the water level in each OHT in the level indicating panel installed in the pump room.
- Each OHT are also provided with a float valve to stop the supply in individual OHT when level reaches a cut off high level.

Control & Indicating Panel (For overhead and underground water tanks)

- A centralized indicating stand–alone wall mounted panel fabricated from 14 g. with seven tank process MS sheet and painted inside and outside with stove enameled finish with clear vertical panels for each group of buildings & tanks shall indicate water level in each tank by means of digital display unit to indicate water level in each tank in four levels (¼th, ½, ¾ and full). The panel shall be installed on the control console panel located in the pump room or as directed by

the Project Engineer. The panel shall have:

- Digital level indicator panel meter for each water tank.
- Etched plate identification plates.
- Control cabling from MCC to the panel installed in the control room as directed by the Project Manager.
- Cabling from PHT sensing probes to the panel.

3.30. WATER TREATMENT PLANT (WTP – IRON REMOVAL PLANT) (Silchar, Udalguri - 5000LPH)

Scope of Work

The scope of work in this subhead shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely do all work relating to the supply, installation, testing & commissioning of Pumping System as described herein after and shown on the drawings and Bill of quantities.

Prepare and submit detailed shop drawings, schematics, and layouts based on the tender drawings and as per site requirements. Ensure compliance with relevant codes, standards, and local regulations.

Shop drawings shall be furnished for detailed layout of all equipment, foundation, bolting and vibration elimination details along with information on dead and dynamic load, vibration etc.

Technical Specification:

1) The proposed WTP is primarily designed for filtration followed by a water softening process. The system offered is manually operated, with individual manual valves. No reduction / removal of TDS, Chlorides, Sulphates, Total alkalinity, BOD, COD & Reactive Silica, etc.,

3) The proposed pH dosing system (230 V) should be looped with existing source motor starter and dosing discharge should be connected with pump outlet suitable provision for fixing near the source pump room starter

4) Since the feed water contains Iron Content, it is suggested to have suitable retention time in the raw water sump - for better treatment cum settlement.

5) Softener exchanges Ca & Mg for equivalent amount of sodium ions (Prevents Ca & mg scaling in pipe lines & fittings, provides soft water for bathing & washing and prevents scaling in heating elements).

6) Though the total Hardness as $CaCO_3$ output of softener is expected to be < 50 ppm. The required blending piping along with valve control – fittings – etc., PH Correction Dosing System

FILTER FEED PUMP

MULTIGRADE FILTER

ACTIVATED CARBON FILTER

IRON REMOVAL FILTER

WATER SOFTNER

NAOCL DOSING SYSTEM

WATER METER

MCC PANEL WITH CABLES

One No. MCC Panel of Non-compartmental Wall mountable indoor - type with suitable incomer, voltmeter, Ammeter with energy meter & outgoing starters & MCB's for the following electrical drives:

i) Feed Pump : 2 Nos. (1W + 1S)

ii) NAOCL Dosing System : 1 No.

iii) Level Switch : 2 Nos. (1 RWL, 1 TWL & TWH with 5 meters cable each)

The above capacity and materials must comply with the guidelines provided by The Engineer and the specifications outlined in the approved Bill of Quantities.

3.31. SEWAGE TREATMENT PLANT (CAMUS –SBT TECHNOLOGY)

General

The enclosed tender drawings. Based on these, the Contractor shall prepare and submit the shop drawings for civil works, plant, and machinery to the Engineer-in-Charge. After receiving the final approval, the Contractor may proceed with the execution of the work.

The proposed capacity for the Camus SBT technology sewage treatment plant is as follows:

1. **Silchar – 100 KLD**
2. **Udalguri - 100 KLD**

The specifications for the above capacities are as per the BOQ.

The Technical requirement given below shall be read in conjunction with the other documents forming part of the contract. In case of any variance, these Technical requirements shall supersede any other conditions mentioned in any contract document.

The materials and workmanship shall satisfy the specifications contained herein and codes referred to. Where the technical specifications stipulate the requirement in addition to those contained in the Standard Codes and specifications those additional requirements shall also be satisfied. In the absence of any Standard / Specifications covering any part of the work

covered in this tender document, the instructions / directions of The Engineer will be binding on the Contractor.

The work shall be carried out strictly as per latest CPWD specifications.

The Work Includes

- Civil, Mechanical & Electrical works
- Piping as specified.
- Testing, commissioning and operation of plant with water and under load conditions.
- Incoming power connection, electrification of pump house.
- Incoming sewer / rising main connection to the plant.
- Connection from final sewage tank / pump to point of use for reuse for flushing of toilets and urinals after that used to irrigation system or for disposal in accordance with approval of the State Board for Prevention and Control of Pollution.

Contractor's Experience

Contractor quoting for the work shall be an experienced specialize Contractor engaged in the design, manufacture and execution of STP of similar types and must have completed at least 5 plants of similar or larger size in the last 5 years.

- Each offer must be accompanied by a list of plants that have been planned, constructed, executed, and in operation for at least 12 months, as follows:
- Owner's name, address, telephones and faxes nos.
- Architects/Consultants name, Address, Telephone & fax nos.
- Type of load (Domestic)
- Average daily flow, BOD and other information of plant.

Shop Drawings

The Contractor shall submit shop drawings as follows:

- On award of the work, Contractor shall submit shop drawing, PIB diagrams, plant layout with basic dimensions, flow diagram with levels of elements.
- Fabrication and equipment layout piping, valves and all other information required for installation.
- Electrical layouts, detail of all MCC, cable sizing and system diagrams and earthing system.
- Piping layout with pipe dia. slopes, fixing arrangements.

- Three copies of the shop drawings shall be submitted for initial scrutiny. On approval of the same Contractor shall submit six copies of the same incorporating corrections etc. Two sets will be stamped “GOOD FOR CONSTRUCTION" by the Consultant and returned to the Contractor.

Other Submittals

Contractor shall furnish four sets of folders giving:

- Catalogues and technical information sheets of equipment to be installed.
- Performance curves, foundation details and fixing arrangements.

Contractor’s proposal for testing procedures for individual equipment and for overall testing of the plant.

Submittals shall be separate for:

- Mechanical and Piping works
- Electrical Works

All shop drawings and submittals mentioned above shall be approved by Architect and two sets duly stamped shall be returned to the Contractor for execution of the works.

Execution of Work

All work shall be executed only in accordance with the approved shop drawings and other submittals. Contractor shall ensure that all inserts, support plates, puddle flanges and other items required to be incorporated during execution shall be placed in position as per his own requirements during execution of the works.

All special tools and tackle required for erection and assembly of the equipment covered by the contract shall be obtained by the Contractor himself. All other materials such as foundation bolt nuts, etc. required for the installation of the plant and equipment shall be supplied by the Contractor and are part of the contract.

Testing & Handing Over

The Contractor shall carryout tests on different equipment as required in the presence of the Consultant or his representative in order to enable him to determine whether the plant, equipment and installation comply with the specifications, local codes and in accordance with the letter and intents of the specifications.

The installation shall be handed over to The Engineer only on successful completion, operational tests and acceptance of the effluent quality by the municipal / pollution control and statutory authorities.

Statutory Permissions

Contractor shall submit a write-up of process of the plant, drawings, design parameters flow

and PIB diagrams as necessary and required for submission to the State pollution control authority.

Contractor shall furnish at his own cost, analysis of influent at source (for evaluation) as well as that of influent at the holding tank of the STP and the effluents from the STP for submitting to State Pollution Control Board and any other statutory authority whose approval is required.

Contractor shall perform all testing and operation of the plant in presence of the Pollution Control Board if so stipulated by them.

Contractor to obtain all statutory approval as required for PCB or any other approval. Only official fee will be reimbursed to Contractor by the Owner.

Completion Documents

On successful completion of the entire work, the Contractor shall submit 4 sets of following documents to Engineer – In-charge. A brief write-up of process, day to day operating and maintenance instructions.

List of approved chemicals and procedure for storage and safety norms.

Completion drawing and data, catalogues, performance charts, technical data sheets and equipment installed.

Manufacturer's maintenance and operating instructions for mechanical and electrical equipment.

Laminated and framed "As Built" drawings with plans, section, process flow diagrams, pipe runs, levels and final disposal point schedule of equipment installed with all their model Nos. plate data and date of installation.

Test readings of Influent & Effluent parameters taken at final handing over time

NOC (No Objection Certificate) from State Pollution Control Board and any other statutory authority whose approval is required.

Performance Guarantee

Equipment supplied and installed shall be guaranteed to yield the specified effluent standards which must meet and accepted with the requirements of Pollution Control Board.

The guarantee implicitly includes replacement of the entire plant on failure to meet desired effluent parameters, replacement of individual equipment or repairs as warranted. Decision on each and every aspect on this matter shall rest with the Consultant and shall be final and binding on the Contractor.

Defects Liability

All equipment and the entire installation shall be guaranteed against defective materials and

workmanship for a period of 24 months reckoned after taking over of system by client along with the documentation. During the defects liability period, the Contractor shall replace defective parts and components free of cost. Rectification or repair may be permitted in case the defect is of minor nature.

General

Supplying, assembly, installation, testing and commissioning of the main treatment units in RCC tanks, mechanical equipment for the Sewage Treatment Plant (STP) of capacity and design parameters for 150KLD and 50KLD respectively specifications broadly comprising of : -

- No external aeration
- Low power consumption
- All green process
- No moving parts
- No bio-sludge formation
- Efficient removal of pollution
- One time media installation ,Long life, Unskilled personnel sufficient to operate
- **Capacity: 100KLD and 25KLD**
- Recovery: More than 98%
- Peak factor: 3
- Bio Mound Area: as per Approved drawings
- GL / IL Level :- As per site
- Other Features: Green Structure, No Secondary Bio-Sludge, Low Energy Requirement, Robust System, Recalcitrant COD Handling, No Odour, Less Start-Up Time.

TECHNICAL SPECIFUCATION OF CAMUS SBT TECHNOLOGY

The Fabricating, Supplying, Installation & Commissioning 25 KLD/100 KLD STP, Supply of mechanical, electrical and instrumentation including

- Fine Screen Chamber SS304, 5mmx5mm,
- Tube Settler,
- Collection /Raw Sewage Tank, Equilization Tank,
- Bio Mound 1 & Bio Mound 2
- Collection Tank 1 & 2,
- Treated Water Tank
- Submersible Sewage pump to transfer fluid between RST-BM1, EQT-BM1

- Submersible Slurry Pump to transfer slurry between RST -VCB,TS -VCB
- Submersible sewage Pump to transfer fluid between CT1-BM2
- Submersible clear water pump to transfer fluid between CT2-TWT
- Bio Mound Media (laterite /Basaltic/red clay origin media with technology provider specified aggregate sizing),
- Jute 250gsm @every 0.5m inside BM media, Plantation/Saplings @2sqm each etc.,

The above capacities of Pumps and details are as per BOQ

Bio Mound (BM) Media

- Bio Mound Media :- As per the BOQ and Approved Drawings
- Jute 250gsm @every 0.5m inside BM media :- As per the BOQ and Approved Drawings
- Plantation/Saplings @2sqm each :- As per the BOQ and Approved Drawings

Electro mechanical Specifications

Slurry Pump TS -VCB; RST - VCB Submersible Slurry Pump; (1W) with Piping , NRVs, Cabling & Other Instrumentation as Applicable Sewage Pump

EQT-BM1;RST -BM1 Submersible Sewage Pump capacity and Piping, NRV, Cabling & Other Instrumentation as Applicable Sewage Pump based on the BOQ.

CT1-BM2; Submersible Sewage Pump capacity and Piping, NRV, Cabling & Other Instrumentation as Applicable Sewage Pump based on the BOQ.

CT2-TWT; Submersible Sewage Pump capacity and Piping, NRV, Cabling & Other Instrumentation as Applicable Sewage Pump based on the BOQ.

- Distributor System in UPVC inclusive fittings; MOC:- UPVC
- Tube Settler Packing; MOC:- PVC
- Fine Screen; MOC:- SS 304; Slot Size:- 5 mm
- Mechanical Flow Meter; Line Size :-2 inch
- Control Panel: - 1 JOB.

The Garden Soils and Garden work for STP plant top level:

Supplying on site fresh Garden soil (free from stones rubbish like dried grass roots, other such materials) for excavation area of depth of 30 cms.(consolidated thickness).(As per P&G DSR 2022-23 Items of garden work,Sr No.36a),, Supplying on site well decomposed Farmyard Manure for excavation area of depth of 30 cms. (Consolidated thickness). (As per P&G DSR 2022-23 Items of garden work,Sr No.36b),, Providing on site required variety of lawn (free from weeds /disease etc.) Cynodon/ paspalum/ selection for 1 sqm. area dibbling

distance 5 cms. apart c/c. (As per P&G DSR 2022-23 Items of garden work,Sr No.46),, Excavation for planting lawn/ shrub/ flower bed/ hedges/ edges/ canna bed in earth, soil of all types, soft murrum, including removing the excavated material up to a distance of 50 mtrs. for a depth of 30 cms.(As per P&G DSR 2022-23 Items of garden work,Sr No.3), Filling fresh garden soil / silt & manure in excavated area of depth 30cms. (As per P&G DSR 2022-23 Items of garden work,Sr No.13),, Mixing garden soil/silt & manure thoroughly well, watering previous night. Planting required plant species, lawn grass as directed etc. complete for required depth 30 cms. for planting lawn/ shrub/ flower bed/ hedges/ edges/ canna bed/ ground cover. (1/10 of semiskilled labour)(As per P&G DSR 2022- 23 Items of garden work,Sr No.23),, Maintenance of Newly Developed lawn Area. For First 30 days Only (Paspalum/ selection)(As per P&G DSR 2022-23 Items of garden work,Sr No.28)

After the commissioning of the STP plant, garden soil must be laid on top of the plant in BM 1 & 2 to support plantation growth. Therefore, laying garden soil over the STP is essential for this purpose.

CAMUS-Cultures and Catalyst; Patent No 414339 METROL Process (Mite Ecology for Treatment of Organic Liquids)

- Process Design (Sizing and Specifications)
- GA Drawings as per site
- Bio Media Identification, Testing and Certification
- Routine Supervision during Civil, Media Filling and Installation of Electro mechanical Items
- Commissioning
- Operation and Maintenance During DLP period (1 year)

    1. Operators:- 2 Nos
    2. Quarterly Site Visit:- 4 Nos
    3. Compliance Water Test Reports (quarterly) for raw water and treated water for parameter COD, BOD, TSS, pH:- 8 Nos

Note: As per relevant IS standards (output water for irrigation/ flushing/ sewer/ portable) for output water parameters should be complied with standard norms.

Si.No	Parameter	Units	Treated Outlet (Less than)	Treated Inlet (Less than)
1	PH		6.5-7.5	6-8.5
2	Biological oxygen Demand	mg/L	10	250
3	Chemical oxygen Demand	mg/L	50	425
4	Total Suspended Solids	mg/L	10	350

After treatment of STP treated water should be adhere to the Standard.

3.32. EFFLUENT TREATMENT PLANT:-

Supply, Installation, and Testing & Commissioning of ETP shall be carried out by the Contractor. The specifications for ETP (Capacity 5 KLD –Two Locations and 20 KLD – Three Location) shall be as defined in Design Basis Report, meeting functional requirements & as per directions of the Engineer –In - Charge.

The Contractor shall submit shop drawing illustrating the detailed piping & instrumentation details of entire ETP system, which shall be approved by PMC prior to start of execution work at site.

Design Method

PLANT CAPACITY	20KLD(Silchar,Udalguri) Effluent Treatment Plant
OPERATION	Semi-automatic, PLC - based
Hours of Operation	20 Hours X 365 days (Except time for general preventive maintenance)
AREA CLASSIFICATION	Non-Hazardous
POWER (V/PH/HZ)	400V/3Ph/50-60Hz as per BOQ
DESIGN TEMPERATURE	Mechanical design: 40°C Process design: 25-30°C

Water Analysis

Si.No	Parameter	Unit	Treated Water Characteristics (Outlet)
1	PH		6.5-7.5
2	TSS	ppm	100
3	BOD	ppm	30
4	COD	ppm	250
5	Oder		Absent
6	Colour		Clear
7	Oil & Grease	ppm	10
8	TDS	ppm	<2100

Civil components:

Screening chamber

The untreated effluent contains bigger suspended solids and floatable matter which

contributes organic and inert matter that needs to be removed from the effluent. Also, there are chances that these particles may clog the pump causing breakdown. The untreated industrial effluent is first passed through the fixed bar screens where all the bigger suspended solids and floatable matter get separated and removed. The screened effluent is then taken to the oil and grease removal tank by gravity.

Equilization And Neutralization Tank

The raw effluent is let into the collection tank and continually mixed with a floating aerator or air-diffused device to homogenize the combined effluent from the hospitals' various sources and maintain similar effluent characteristics. The pH is generally low. As a result, the effluent is fully mixed by dosing lime, caustic soda, or soda ash in the Collection tank to neutralize the pH of the raw effluent before it is discharged into the subsequent units. The equalization tank will balance out fluctuations in the flow and quality of raw effluent and maintain a consistent and uniform supply of composite effluent to the succeeding treatment units in terms of flow and quality. Agitation will be run as needed and will regulate itself based on the liquid level in the tank.

Coagulation And Flocculation

Treatment of industrial and municipal waste water that may contain colloidal solids, i.e., particles that are too small or light to filter out, requires flash mixing, coagulation, and flocculation. To encourage sedimentation and agglomeration in bigger particles, flash mixing, coagulation, and flocculation are essential. After the coagulation and flash mixing phases, flocculation occurs. The particles that have been removed from the water are transported to larger clumps, or flocs, during this phase. They might do this so that they may settle in the sedimentation chamber and be divided by the water that was directed to the drain. The reaction with a polymeric solution that functions as a flocculent agent, such as poly electrolytes or polyamines, makes this process possible.

Primary Tube Settler

The effluent from the Flash Mixing Tank is pumped to the primary tube settler. TS is used to remove suspended solids which are treated with coagulants and flocculants. The supernatant from the TS enters the Anaerobic Baffle Reactor. Sludge from the clarifier is sent to the sludge holding tank/s. The supernatant from the Tube Settler will be sent to the Equalization Tank of the Sewage Treatment Plant for further Treatment. While Sludge will be sent to the Sludge Collection Tank of the Sewage Treatment Plant.

3.33. SOLAR WATER HEATING SYSTEM –

(Silchar, Udalguri -1000LPD)

Design, Supply, Installation, Testing & Commissioning of Solar Water Heating system shall be carried out by the Contractor & as directed by Engineer-in-charge. Solar water heating (SWH) is the conversion of sunlight into renewable energy for water heating using a solar thermal collector. For Hospital Building Close Coupled Solar Hot Water System coupled with Heat Pumps shall be used. In a "close-coupled" SWH system the storage tank is horizontally mounted immediately above the solar collectors on the roof. No pumping is required as the hot water naturally rises into the tank through thermo siphon flow. Solar water heating system produces hot water at a temperature of 60 Deg. C and In accordance with the IS-12976:1990 and IS12933:1990 (Part 1 to part 5).

Solar hot water system may be with recirculation pump & heat exchanger system, pump to supply water from raw water storage tank to solar storage tank if height of storage tank is higher than raw water storage tank.

System to ensure that the solar hot water generated during the sunshine hours of the day is stored in a Solar Insulated tank (Heat Bank) & then the Heat is transferred to the Mixing tank as & when required (HTC application), so that the Hot Water is made available at the Controlled Temperature for final usage. In other buildings, conventional Solar Hot Water System shall be used without any recirculation pumps. It supplies the hot water by gravity as a preheated water to the electric geysers at all user points Testing: All G.I pipes of Primary Circuit (Collector Circuits) shall be tested to hydro-statically for a period of 30 minutes to a pressure of 2 kg/Sq.cm without drop in pressure and all other G.I pipes for a pressure of 6 Kg/Sq.cm.

3.34. HOT WATER STORAGE TANK

SS-304 horizontal/vertical hot water storage tank with the required thickness (as Required) to withstand working pressure of 5 kg/sq cm. The hot water storage tank is provided with a manhole, cover, drain, vent, overflow, inlet and outlet connections etc as required and as per direction of The Engineer. Each hot water storage tank shall be provided with the following:

- Thermostatic control valve
- Safety valve
- One AIR Release valve
- Pressure and temperature relief valve
- High limit Temperature sensor
- Primary flow connection
- Hot water supply connection
- Hot water return connection
- Drain connection
- Thermometer fitted (inserted) in thermo well
- Pressure gauge

- Make up tank
- Ball valve
- The hot water storage tank shall be hydro-statically tested to one and half times the working pressure of a system for a period of 24 hours without any leak. Field tests are to be performed at site to satisfy the capacity and operation of the unit by the CLIENT/ project in-charge.

3.35. HOT WATER PIPING

Supply and return pipes of the hot water system complete with necessary pipes, bends, flanges, fittings, gaskets and valves are to be provided to connect Solar water heating system , hot water storage tank.

The hot water supply and return pipes are insulated with Rock wool and cladded with aluminium sheets of 24SWG.

3.36. HOT WATER SOLAR PIPING

GI/CPVC/UPVC solar hot water piping complete with bends, flanges, fittings, gaskets and valves to connect the solar panels to the hot water storage tank with necessary valves and fittings. This also includes the solar circulation pumps as per requirement to circulate the hot water to the tank from the solar panels. The hot water piping insulated with Rock wool and cladded with aluminium sheets.

Pipe Insulation

Pipe insulation shall be as required under “HOT INSULATION”.

Installation

Pipe installation shall be carried out with proper workmanship in accordance with approved drawings/ The Engineer. Pipe shall be aligned parallel to walls and ceiling and not across the room. Change of direction shall be through hydraulically formed welding fittings as specified. Alignment shall follow the approved drawings/ The Engineer and wherever necessary pipe shall be rerouted under the instructions of The Engineer in order to meet the site conditions and or interference from other services.

Solar Collector Panels

The scope of work covers supply, erection, testing and commissioning of the Solar Collector Panels meeting the requirements and the intent of this specifications and Capacity.

Manufacturer’s catalogues and guaranteed performance details to be submitted for Approvals before ordering the supply of the equipment.

a. Collector: Type: copper type with minimum size of 2 square meter of each type.

i) Collector Frame Extruded -

ii) Gasket for Glass (Beading) - iii) Glazing (Cover) - iv) Collector Body v) Bottom Insulation - vi) Side Insulation vii) Absorber Plate - ix) Riser Copper - x) Inlet Header Copper - xi) Reflective Foil xii) Grommet xiii) Collector Back sheet

Collector Support Frame

The structure should be in a position to withstand a wind velocity of 100 Km/hr. It shall be made of angle iron 40mm x40mmx5mm and shall have vertical support at top and bottom edge of the inclined plane of the collector at a distance of 2.5 m or less. The vertical support shall be firmly grouted to the roof in the ground in case of ground mounted system. The grouting blocks shall be of minimum equal to 250 mm x 250 mm x 150 mm and finished properly. In case the grouting is carried out on roof already water proofed with asphalt the back support of the collectors may be anchored to the parapet or the size of the grouting block shall be increased to provide for a dead weight anchoring of 75 kg per leg of the vertical support.

Items which are not mentioned in below list but required at site, can be taken from the approved list of Approved make of PWD Assam etc. Furthermore, the materials/equipment to be used which are not mentioned in any of the below list should have ISI or equivalent it shall be Certified from the engineer in charge during execution.

4.1. TECHNICAL SPECIFICATION OF FIRE FIGHTING WORKS

4.2. SCOPE OF WORK

The scope of work includes the supply, erection, and painting, testing, commissioning, and handing over of a complete Fire Protection System, as envisaged for all buildings in accordance with the stipulations of the National Building Code – 2016.

The work under this section consists of providing all labor, materials, equipment, and accessories necessary to fully install the firefighting equipment, as specified hereinafter.

4.3. DRAWINGS & TECHNICAL SUBMITTAL

a) After the award of the work, the Contractor shall submit shop drawings for the entire pumping installations covered under this contract, along with supporting documents and general arrangement drawings for major equipment related to the Fire Hydrant and Sprinkler Systems. The Contractor shall also promptly provide any clarifications or explanations as requested by The Engineer to ensure the timely finalization of the design. All work shall be executed in accordance with the approved shop drawings and technical submittals provided by the Contractor.

b) On Completion of Work The Contractor shall submit O&M manuals for Hydrant and Sprinkler System including pumps, motors, diesel engines, MCC panels, Circuit Diagram, Manufacturers technical catalogues, detailed specification of items provided along with as built drawings and copies of Test Certificates of all major equipment's duly bound in neat and presentable booklet forms.

4.4. APPROVAL BY LOCAL FIRE SERVICE

The Contractor shall be fully responsible and shall carry out following activities:-

a. Obtaining the approval of Entire Fire Fighting System drawings

b. Arranging inspection of site by officials of the Authority

c. Obtaining the final no objection/ completion certificate after submitting required documents.

d. Any other statutory approvals require.

e. The Contractor to get the approval in stages from the Local fire Service as required. This shall be without any liability to the Engineer-In-Charge.

f. On successful completion of work, the Contractor shall prepare as built drawings which have been so approved by the Fire Service incorporating all changes that might have been effected during execution of the work.

g. The Contractor shall also bring to the notice of The Engineer any deviations from Local Fire Service/Building Bye Laws Norms and requirements in the systems that he shall install as well as architectural features that will affect approval from the Fire Service.

4.5. MANUFACTURING

The responsibility for ensuring the manufacture of the equipment as per the specifications shall be solely that of the contractor. The contractor shall be responsible for selection of materials as per agreed specifications.

4.6. MAKE OF MATRIALS

Only approved makes as mentioned in our approved make list of tender documents that material shall be used. The contractor shall get the samples of required items approved from the engineer before commencing the supply.

4.7. TRAINING OF DEPARTMENT PERSONNEL

a. The Contractor shall train the CLIENT personnel to become proficient in operating the equipment installed. Training shall be done before the expiry of the defects liability period (one year after completion & handing over).

b. The period of training shall be adequate and mutually agreed upon by the Engineer and Contractor.

c. The CLIENT personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing, minor repairs and replacement.

d. Nothing extra shall be paid to the Contractor for training CLIENT personnel.

4.8. COORDINATION

The contractor shall co-ordinate with all other agencies involved at the site of work so that the work of other agencies is not hampered due to delay in his work. Piping, cabling or any other work, which directly affect the progress of work of other agencies, shall be given priority.

4.9. WORKS TO BE DONE BY THE CONTRACTOR

Unless otherwise mentioned in the tender documents, the following works shall

Be done by the contractor.

(i) Foundations for equipment including foundation bolts and vibration isolation spring/pads,

(ii) Suspenders, brackets and floor/wall supports for suspending/supporting pipes.

(iii) Suspenders and/or cable trays for laying the cables,

(iv) Excavation and refilling of trenches in soil wherever the pipes are to be laid directly in ground, including necessary base treatment and supports.

(v) Sealing of all floor slab/wall openings provided by the Department or made by the contractor for pipes and cables, from fire safety point of view, after laying of the same.

(vi) Painting of all exposed metal surfaces of equipment and components with appropriate colour as per following standard.

1. The entire metal work above ground level shall be painted with red color shade No. 536 of IS: 5.
2. Pump, motor and engine shall be painted with red color shade No. 536 of IS: 5.

(vii) Making openings in the walls/floors/slabs or modification in the existing openings wherever provided for carrying pipe line, cables etc.

(viii) All electrical works including cable/wires, earthing etc. beyond power supply made available by the department.

(ix) Making good all damages caused to the structure during installation and restoring the same to their original finish.

(x) Approval from local fire authorities as may be required as per local bye-laws.

4.10. COMPLETION / AS BUILT DRAWINGS

Three sets of the following laminated drawings shall be submitted by the contractor while handing over the installation to the Department. Out of this one of the sets shall be laminated on a hard base for display in the fire control room. In addition, one set will be given on compact disc.

(a) Installation drawings giving complete details of all the equipment, including their foundations,

(b) Plumbing layout drawings giving sizes and lengths of all the pipes and the 9 sizes and locations of all types of valves, and including isometric drawings for the entire piping including the pipe connections to the various equipment,

(c) Line diagram and layout of all electrical control panels giving switch gear ratings and their disposition, cable feeder sizes and their layout,

(d) Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits.

(e) Location of External Hydrants, 2-way/4-way fire brigade inlet connection, Earth pipes, route of earthling conductors etc. Route of all cables and pipes run along with detail sizes and mode of installation.

4.11. DOCUMENTS

Three sets of the following documents shall be furnished to the department by the contractor on completion of work:-

(a) Completion drawings as per Para 4.5

(b) 3 sets of manufacturer's technical catalogues of all equipment and Accessories.

(c) Operation and maintenance manual of all major equipment, detailing all Adjustments, operation and maintenance procedure.

(d) Name plate details of all equipment.

(e) NOC from Fire authority before commencement of execution & after completion of entire work etc.

4.12. TECHNICAL SPECIFICATION OF FIRE FIGHTING WORKS

The Work under this sub-head consists of furnishing all labour, materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the followings:

- Providing M.S. black steel (Class C) pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Painting of pipe and Making Connection to supply system.
- Black Steel Pipe, Mains Laterals, Branches, Valves, Hangers and Appurtenances.
- Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets, Sprinkler heads and Landing Valves.
- Portable Fire Extinguishers.
- Fire Fighting Pumps, diesel operated pumps, and water curtain pump, panels and all connected accessories including suction & delivery pipes.
- Testing Commissioning and giving live demonstrations to the various Inspection Authorities and Obtain their "No Objection Certificate" (NOC) for occupation of the building.

4.13. GENERAL REQUIREMENTS

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

Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in shaft, passage etc.

Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.

Valves and other appurtenance shall be so located that they are easily accessible for operation, repairs and maintenance.

4.14. PIPES FOR WET RISER SYSTEM

Scope of Work

This section covers the details of requirement of piping used in wet riser system, including the associated auxiliary equipment.

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:

- Pipes 150 mm dia and below IS: 1239 (Class C) Heavy Class
- Pipe 200 mm dia and above IS 3589 of thickness specified.

Pipe Fittings

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality.

Fabricated fittings shall not be permitted for pipe diameters 50 mm and below.

When used, they shall be fabricated, welded and inspected in workshops under supervision of The Engineer whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

Jointing

Screwed (50 mm dia. pipes and below)

Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed MS forged fittings).

Welding (65 mm dia. and above)

Joints between MS pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to x ray test from an approved agency as per the TAC norms at the cost of Contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase rectifier of required current and capacity. The vendor for welding will be approved by Engineer-in-Charge

Flanges

Flanged joints shall be provided on:

- Straight runs not exceeding 30 m on pipelines 80 mm dia. and above.
- Both ends of any fabricated fittings e.g. bend tees etc. of 65 mm dia. or larger diameter.
- For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of with 3 mm insertion neoprene gasket complete.

Unions

Provide Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

Dia Of Flange And Hole Conforming Is:

Size of pipe - 80 mm 100 mm 150 mm 200 mm

Dia of flange - 200 mm 220 mm 285 mm 340 mm

Flange thickness - 20mm 20mm 22mm 24mm

Dia of bolt - 16 mm 16 mm 16 mm 16 mm

No. of hole - 4 mm 4 mm 8 mm 8 mm

Pipe Protection

All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.

All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.

Pipe Supports

All pipes shall be adequately supported from ceiling or walls from existing/new inserts by structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in approved shop drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.

Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

Testing

All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 kg/cm2 without drop in the pressure for at least 2 hours. Rectify all leakages, make adjustment and retest as required.

Anchor Block

Contractor shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

Valves, Gauge, Orifice Plates and Water flow meter

Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1984, valves up to 65mm shall be of Gunmetal Full Way Valve with wheel tested to 20 kg/cm2 class-II as per I.S: 778-1984. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.

Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

Supply, fixing, testing and commissioning of screwed type brass/bronze lever operated ball valve of full flow with stainless steel ball (AISI 304 & spindle AISI 410) with setting & gland of superior quality having minimum working pressure of 16 kg/sq cm.

Providing and fixing 25 mm dia inspection & testing assembly with gun metal ball valve, gun metal sight glass ,Reducer ,union, G.I PIPE. connection to drain pipe/riser.

Providing, fixing water flow meter on test line complete with all accessories for flow indication , monitoring & testing of fire pumps with bypass arrangement including piping & bypass valves.

4.15. EXTERNAL YARD HYDRANTS

The Contractor shall provide Single headed External Fire Hydrant in the Ring or on External Fire Line, as per specifications as specified in Indicative Items. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet size 76.8 x 61.44 x 25.80 cm, of 2 hrs fire rating as specified in Indicative Items as approved by The Engineer to equip 2 nos. of 63 mm dia, 15 meter long non percolating reinforced rubber line (RRL) hoses, one no. branch pipe and accessories as required. The cabinet shall be installed near the Hydrant as per details, approved by the Engineer-In-Charge. The fire hose cabinet shall have with glass fronted double door with lock and keys and break glass recess for keys all complete. The glazed glass shall be of minimum 6mm thickness or as specified in the Indicative Items.

The FHC shall be red painted. The words “yard hydrant”, “hydrant” etc. shall be painted in white (or red on the glass) in 75mm high letters. The hose box shall be lockable with socket spanner. Top surfaces shall be slopped for water discharge. Vents shall also be located on sides of the Hose Box.

A brick pedestal with brick wall complex with plaster shall also be constructed for supporting the hose box. All surfaces shall be plastered with 1:4 ratios (1 cement: 4 fine sand) mortar.

Sample of one installation to be approved before proceeding with execution

4.16. ANTI-CORROSIVE PROTECTION ON UNDER GROUND MS PIPE

Corrosion protection tape shall be wrapped on MS pipes to be buried in ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fiber and minimum 4 mm thick and conform to requirement of IS : 10221-Code of practice for coating and wrapping of underground mild steel pipe line. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall be 15 mm and 250 mm shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated in situ after the pipe line is installed. The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre-heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry. Holiday Testing for wrapping and coating is essential. Holiday testing may preferably be carried by flexible and detachable ring probe, which will enable the entire 360 Deg. of the surface of the pipe to be scanned. At least 10 percent of all the welded joints shall be radio graphically tested and half of the joints radio graphed shall be the 'field joints'.

4.17. INTERNAL HYDRANTS

The Single headed Internal Hydrant outlet shall be as per IS: 5290 (Type-A), and as specified in the Indicative Items.

a) A cap with chain is provided on the head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.

b) The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

c) The Hydrant shall be constructed from Stainless steel and finished to a smooth polish on screwed ends. The Hydrant shall have screwed inlet of 80mm dia. flanged type with 4 nos. holes. The Hydrant shall have a PVC plug with chain fixed to the main body of the Hydrant. The Hydrant shall be tested to minimum 20 kg / cm^2 test pressure. The Hydrant shall not leak at any screwed joint.

4.18. FIRST-AID HOSE REEL EQUIPMENT

First aid hose reel equipment shall comprise reel, drum which can swing up to 170 degrees, with hose, guide fixing wall bracket, hose tubing, globe valve, stopcock and nozzle. This

shall conform to IS: 884 - 1969. The hose tubing shall confirm to IS: 444- 1980 or IS: 12585 (Thermoplastic). The drum shall be fabricated from GI sheet of minimum 18-gauge thickness or as specified in the Indicative Items.

a) The hose tubing shall be 20 mm dia and 36.50 m long, or as specified in the Indicative Items. The G.M. nozzle 5mm and shutoff valve shall be of 25 mm size to shut off the water supply to the Hose Reel, or as specified in the Indicative Items.

b) The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the M.S. pipe riser through a 25mm dia pipe.

c) MS bracket shall be fixed on the wall to which the first aid hose reel shall be bolted. The bracket shall be of 40x40x5mm thick MS angle to form a square of 400x400 mm approx. This shall be fixed on the wall. After approval of sample by Engineer-In Charge further units shall be fabricated in factory and all joints shall be finished with grinder and shall be spray painted after single coat of primer paint.

4.19. HOSE PIPES, BRANCH PIPES & NOZZLES

HOSE PIPES

a) Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall confirm to type A (Reinforced rubber lined) of IS: 636 - 2018. The hose shall be sufficiently flexible and capable of being rolled.

b) Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

Branch Pipes

Branch pipe shall be of Gunmetal 63 mm dia. and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Nozzle

The nozzle shall be of Gunmetal 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.End Couplings, Branch pipe, and Nozzles shall conform to IS: 903 - 1985.

Orifice Plate

The pressure in a Fire Fighting system varies from point to point. The pressure will be maximum in the pump house and minimum at the farthest hydrant at top level. To reduce pressure to operating pressure at every internal/external hydrant, orifice plates are provided before connection of landing valve between the flanges of landing valve and pipe flange.

Strainers

Stainless steel strainers shall have minimum 1mm thick screen with 3 mm perforations. Strainers hall be provided with flanges.

Hose Cabinet

The internal hose cabinet shall accommodate the Hose pipes, branch pipe, Nozzle First Aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge MS/ aluminium sheet. The overall size shall be minimum requirement 2100x900x800 mm, or as specified in the Architectural details. This shall have lockable center opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

Providing and fixing Fire Shaft Door of size 900mmx2100mm made of 16 gauge thick MS sheet with 4 mm thick front glass doors in front painted "FIRE" in red paint i/c necessary locking /Key arrangement shall be painted with one coat of primer & two coat of finished stove enameled post office red colour paint .

The hose cabinet shall be painted red and stove enamelled and woods FIRE written in front glazed portion.

Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

4.20. FIRE BRIGADE INLET CONNECTIONS

One set of 2/4 ways collector head Fire Brigade connection shall be provided at underground tank, Ring Main, Sprinkler system and individual wet risers as specified conforming to IS 904.

The inlet to the wet riser sprinkler header shall be with 150 mm diameter butterfly or sluice valve and non-return valve. The scope shall include necessary reducers, tees bends and special fittings as required.

It should be provided with M.S. enclosure fabricated from 1.5 mm thick M.S. sheet, front glass locking arrangement supported on M.S. structural members, painting with two coats of postal red enamel.

Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified, for the following purposes:

Fire Brigade suction connection for fire static tank with provision of foot valve.

Fire brigade inlet connection to fire static tank.

The locations of this Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

Hydraulic Siren

A siren shall be provided in the system, to indicate the flow of water in the wet riser system. Alternative arrangements may also be adopted. This shall be turbine type.

Fireman Axe

Providing and fixing standard fireman's axe with heavy insulated rubber handle conforming to IS: 926 complete.

Valve Chambers

Contractor shall provide suitable Brick Masonry Chamber in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

Valve chambers shall be of following size:

- For depths 100 cm and beyond 90x90x100 cm

Sprinkler Heads

a. Sprinkler heads shall be quick response type of quartzoid bulb type with bulb, valve assembly yoke and the deflector, rosette plate & complete with all accessories & shall be UL listed & FM approved . The sprinklers shall be as per IS: 9972of approved make and according to type of discharge.

b. Types

I. Conventional Pattern

ii. The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown . The sprinklers shall be suitable for erection in upright position or pendant position. The designing of installation will be as per IS 15105.

iii. Spray Pattern

iv. The spray type sprinkler shall produce a hemispherical discharge below the plane of the deflector.

v. Ceiling (flush) Pattern vi. These shall be designed for use with concealed pipe work. These shall be installed pendant with plate or base flush to the ceiling with below the ceiling.

C. Side Wall Sprinklers

i. These shall be designed for installation along with the walls of room close to the ceiling. The discharge pattern shall be similar to one quarter of sphere with a small proportion discharging on the wall behind the sprinklers.

d. Constructions

i. Bulb:- Bulb shall be made of corrosion free material strong enough to with stand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.

ii. Valve Assembly: - Water passage of the sprinkler shall be closed by a valve assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.

iii. Yoke: - The yoke shall be made of high quality gun metal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anti-corrosive treatment if the same is housed in corrosive conditions.

iv. Deflector: - The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler

e. Colour Code

The following color code shall be adopted for classification of sprinkler according to nominal temperature ratings:

Sprinkler Temperature Rating	Color of the Bulb
68 deg. C	Red

f. Size of Sprinklers Orifices The following sizes of sprinklers shall be selected for various classes or hazards.

Light hazard - 15 mm nominal bore

g. All measures to be considered so that sprinkler bulb is cleaned & free from any blemishes.

h. Sprinkler type (pendant/upright/sidewall) shall be conforming to requirements & relevant IS codes.

4.21. PIPES AND FITTINGS

a. Pipes

i. Pipes less than 25mm dia shall not be used and shall be Black Steel conforming to IS: 1239 (Heavy Class) up to 150mm.

ii. Welded Black Steel Pipe, Heavy Class conforming to IS:3589 for size greater than 150mm.

iii. Fittings for black steel pipes shall be malleable iron suitable for welding or approved type cast iron fittings with tapered screwed threads.

b. Jointing

Joint for black steel pipes and fittings shall be metal to metal tapered thread or welded joints. A small amount of red lead may be used for lubrication and rust prevention in threaded joints. For Pipe size up to 50mm, Thread Joints are to be considered and for Pipe size above 50mm, Welded joints are to be considered.

Joints between MS pipes, valves and other appurtenances, pumps etc. shall be made with M.S. flanges with appropriate number of bolts. Flanged joints shall be made with 3mm thick insertion rubber gasket.

c. Pipe Protection

i. All pipes above ground and in exposed locations shall be painted with one coat of red oxide primer and two or more coats of synthetic enamel paint of approved shade. ii. Pipes in chase or buried underground shall be painted with two coats of hot bitumen, wrapped with bituminous Hessian cloth and finished with one coat of hot bitumen paint.

d. Pipe Supports

All pipes shall be adequately supported from ceiling or walls from existing inserts by structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of red and two coats of black enamel paint. Where inserts are not provided, the Contractor shall provide anchor fasteners.

Supplying, installation, testing & commissioning of sprinkler flexible pipe (UL Listed) of stainless steel complete with 15 NPT on reducer thread with

maximum working pressure of 175 PSI test pressure of 875 PSI (Burst) with branch line (Inlet) 25mm NPT male thread to sprinkler head (Outlet) 15mm NPT female thread with reducer, nipple, 2 side brackets, center bracket, stock bar of following sizes complete as required.

e. Orifice Flanges

Contractor shall provide orifice flanges fabricated from 6mm thick Brass plates on the branch lines feeding different zones/ floors so as allow required flow of water at 3.5 kg/ sq.mm pressure. The Contractor shall furnish design for these orifice flanges.

f. Valves Butterfly or Sluice valves of size 80mm and above shall be double flanged cast iron conforming to IS: 780. Check valve shall be of cast iron double flanged conforming to IS: 5312. Valves on pipes 65mm and below shall be heavy pattern gunmetal valves with cast iron wheel seat tested to 20 kg/ sq.mm pressure. Valves shall conform to IS: 778.

g. Air Valves 25mm dia screwed inlet cast iron single acting air valves on all high points in the system or as shown on drawings.

h. Drain Valves 50 m dia black steel pipe conforming to IS: 1239 heavy class with 50 mm gunmetal full way valve for draining water in the system in low pockets

Automatic sprinkler system shall be provided in the building as per requirement with permitted exceptions e.g. electrical switch rooms, power transformers and D.G. rooms, Panel rooms, Electrical rooms as identified

Sprinkler heads shall be provided at approximate spacing to cover 9 to 12 m2 per Sprinkler head. The spacing shall however, be in conformity with the approved drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling.

Sprinkler heads shall be chrome finished Brass/Gunmetal with quartz bulb with a temperature rating of 68°C. Sprinkler heads shall be of type and quality approved by the local fire brigade authority. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special application side wall Sprinkler types as shown in approved shop drawings. All Sprinklers should have the Specifications.

Contractor shall supply spare Sprinkler Heads of each type as per requirement and one Spanner for each type of sprinkler neatly installed in a steel box with glass shutters at locations approved by the Engineer-in-Charge.

Rosette Plate

Providing, installation, testing & commissioning of adjustable rosette plate for 15mm dia in white finish UL Listed or FM approved complete as required.

4.22. ALARM VALVE & AUTOMATIC WATER MOTOR GONG VALVE

The alarm valve & water motor gong valve UL approved shall be provided on the Sprinkler main delivery pipe complete in all respects.

a) The alarm valve & water motor gong valve is to be provided on all the Sprinkler main delivery pipes or Installation Control Valves as per approval of authority having jurisdiction.

b) The Installation Control valve shall be double seated clapper type check valve. The Body and cover shall be made from Cast Iron to IS: 210 Grade FG 200. The seat and seat clamp shall be made from bronze to IS: 318, LTB II grade. The sealing to the seat shall be neoprene gasket. The hinges pin and ball shall be from stainless steel.

c) It shall be vertically mounted and the direction of water travel shall be indicated on the surface. It shall be rated to 12 kg / cm² and tested to 25 kg / cm² pressure.

d) A By-pass check valve shall be fitted to adjust minor and slow variations in water pressure for balancing so as to avoid any false alarm.

e) The valve shall also be provided with a Test Control Box. The Box shall house a lever to test and operate the ICV. A brass strainer shall also be provided at the point of water supply to the Alarm gong. A Retarding Chamber shall also be provided. The Chamber shall be able to balance the water pressure in case of water line surges.

f) Each Installation Control Valve shall have two sets of pressure Gauges with brass ball valve type shut off.

g) A Water Motor Alarm shall also be provided. This shall be mechanically operated by discharge of water through an impeller. The drive bearing shall be weather resistant. A strainer shall be provided on line before the nozzle. The Gong piece shall be constructed from bronze to IS 318, 2 TB II Grade, and base of cast iron. The motor Housing, Rotor and Housing Cover shall be pressure die cast aluminium.

h) A brass automatic ball drop valve with the retard chamber shall also be provided.

Pressure Gauges:

Pressure gauges shall be provided immediately above and below each alarm valve.

Stop cock shall be provide before pressure gauges for removal without interruption of water supply of the installation. Pressure gauges shall be as per IS:3624

Inspector Test Valves

The Inspectors Test Valve assembly is to be provided on the Sprinkler System pipes in location as per approval of authority having jurisdiction.

Flow Switches

The Flow Switches are to be provided on the Sprinkler System pipes for each zone, complete with all necessary wiring up to monitor modules as per instructions of the Engineer-In-Charge.

4.23. INTELLIGENT TYPE SPRINKLER ANNUNCIATION PANEL & MONITOR MODULES

For detailed specification kindly refer Package of Addressable Type Fire Alarm and detection system

Voice Evacuation System

Multi storied building shall be provided with Voice evacuation system at all floors as per NBC 2016 standard. This system is an electronic sound amplification and distribution system with a microphone, amplifier and loudspeakers used to allow a person to address an occupant at all floor level of the building. The term is also used for systems which may additionally have a mixing console, and amplifiers and loudspeakers suitable for broadcasting any message, distributing throughout the building. The system shall include the following.

Speakers with Sufficient capacity, ceiling / wall mounted type shall be provided in corridor and common areas, large rooms, parking areas etc.

Control Console should be Integrated 8 channel Digital Voice Evacuation System Controller capable of broadcasting Evacuation Messages on same peer-to-peer Network with the fire detection Control Panel as per The Cause & effect matrix

Console with microphone for Voice evacuation system shall be located in the main of the building at ground floor for easy accessible.

System should be capable of supervising all the speaker circuits with adequate zone control and accessories.

Failure of Fire Panel CPU shall not result in failure of DVC operation.

Each floor shall be considered as a separate zone. Speakers in each zone are connected to the console using fire retardant cable.

Announcement from the main control Centre in ground floor to upper floor levels shall be done in case of Emergency by individual zone or collectively to all zones.

If there is any other Announcement system is there, it has to override with Voice evacuation announcement in case of emergency.

Wiring to speakers and between floors 2Cx1.5 mm^2 armored FRLS, PVC insulated copper conductor cable.

Fire Command Centre

As per NBC 3.2.1 Fire command Centre shall be on the entrance floor of the building having direct access. The control room shall have the main fire alarm panel with communication system (suitable public address system) to aid floors and facilities for receiving the message from different floors.

Fire command Centre shall be constructed with 120 min rating walls with a fire door and shall be provided with emergency lighting. Interior finishes shall not use any flammable materials. All controls and monitoring of fire alarm systems, pressurization systems, smoke management systems shall happen from this room. Monitoring of integrated building management systems, CCTV or any other critical parameters in building may also be from the same room.

Details of all floor plans along with the details of firefighting equipment and installations (2 sets laminated and bound) shall be maintained in fire command Center.

The fire staff in charge of the fire command Center shall be responsible for the maintenance of the various services and firefighting equipment and installations in coordination with security, electrical and civil staff of the building

Fire Fighters Telephone System

All the exit doors to Fire escape staircases has to be provided with Addressable Fire Fighter's Telephone Jack with suitable supervised module along with Portable Type Fire Telephone Handset for two-way communication between Remote Fire Fighter & Fire Command Center.

The Fire Detection panel integrated with Digital Voice Evacuation System Controller Should has an inbuilt 2 ways Communication Fire Fighters System. The Fire Fighters Telephone System shall be capable of having minimum 30 Telephones in conference in multiple FFT Risers.

4.24. PORTABLE FIRE EXTINGUISHER

The Extinguisher shall be filled with ABC Grade 40, Mono Ammonium Phosphate (MAP base) from approved manufacturer.

The Capacity of the extinguisher when filled with Dry Chemical Powder (First filling) as per IS 15683, part II 8/ IS 2171, shall be 4.0 kg +/-2 % or 10 kg +/-3 %.

It shall be operated upright, with a squeeze grip valve to control discharge. The plunger neck shall have a safety city, fitted with a pin, to prevent accidental discharge. It shall be pressurized with Dry Nitrogen, as expelling. The Nitrogen to be charged at a pressure of 15 kg / cm^2. 25

Body shall be of mild steel conforming to relevant IS Standards. The neck ring shall be also mild steel and welded to the body. The discharge valve body shall be forged brass or leaded bronze, while the spindle, spring and siphon tube shall be of brass. The nozzle shall be of brass, while the hose shall be of braided nylon. The body shall be cylindrical in shape, with the dish and dome welded to it. Sufficient space for Nitrogen gas shall be provided inside the body, above the powder filling.

The Neck ring shall be externally threaded the threading portion being 1.6 cm. The filler opening in the neck ring shall not less then 50 mm. Discharge nozzle shall be screwed to the hose. The design of the nozzle shall meet the performance requirement, so as to discharge at least 85 % of contents upto a throw of 4 meters, continuously, at least for 15 seconds. The hose, forming part of discharge nozzle, shall be 500 mm long, with 10 mm dia internally for 5 kg capacity and 12 mm for 10 kg capacity. It shall have a pressure gauge fitted to the valve assembly or the cylinder to indicate pressure available inside.

The extinguisher shall be treated with anti corrosive paint, and it shall be labeled with words ABC 2.5 cm long, within a triangle of 5 cm on each face. The extinguisher body and valve assembly shall withstand internal pressure of 30 kg / cm^2 for a minimum period of 2 minutes. The pressure Gauge shall be imported and suited for the purpose.

Portable fire extinguishers shall confirm to IS:15683.

- Two 9 lit. water CO2 type for every 600 m2 area with minimum of 1 extinguisher per floor as per I.S: 15683
- Dry Chemical powder type of 6 Kg. Capacity as per (IS:15683)
- CO2 type of 4.5 kg capacity as per (IS:15683)

4.25. CARBON DIOXIDE EXTINGUISHER

- The Carbon Dioxide Extinguisher shall be as per IS: 15683.
- The Body shall be constructed of seamless tube conforming to IS: 7285, and having a convex dome and flat base. Its dia shall be maximum 140 mm, and the overlay height shall not exceed 720 mm.
- The discharge mechanism shall be through a control valve conforming to IS: 3224. The internal siphon tube shall be of copper or aluminum conforming to relevant specifications. Hose pipe shall be high pressure braided Rubber hose with a minimum burst pressure of 140 kg/cm^2, and shall be approximately 1.0 meters in length having internal dia of 10 mm. The discharge horn shall be of high quality unbreakable plastic with gradually expanding shape, to convert liquid carbon dioxide into gas form. The hand grip of Discharge horn shall be insulated with Rubber of appropriate thickness.
- The gas shall be conforming to IS: 307 and shall be stored at about 85 kg/cm^2. The expansion ratio between stored liquid carbon dioxide to expanded gas shall be 1:9 times and total discharge time shall be minimum 10 sec. and Maximum 25 sec.

- The extinguisher shall fulfill the following test pressures: a) Cylinder: 236 kg/cm² b) Control Valve: 125 kg/cm² c) Burst pressure of Hose: 140 kg/cm² minimum. 26
- It shall be an upright type. The cylinder, including the control valve and high pressure Discharge Hose must comply with relevant Statutory Regulations, and be approved by chief Controller of Explosives, Nagpur and also bear IS marking.
- The Extinguisher including components shall be ISI Mark.

Fire Buckets

A. Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

B. Supply and fixing of 4 Nos G.I round bottom FIRE BUCKET of 9 LTR. Capacity field with sand including proper supporting /mounting arrangement MS Angle Iron Frame painted by fire red colour over 2 coats of red oxide paint and written with white paint FIRE complete in all respects as per direction of Engineer In charge .

Clean Agent

Providing and fixing 2 kg capacity clean agent - HFC 236FA Stored Pressure type fire extinguisher ISI marked under IS:15683 complete with imported manufactured by 3M, with Zero Ozone Depletion Potential and Very Low Global Warming Potential of 1 with 20 Years Blue Sky Warranty against any regulatory Bans and Restrictions.

Fire Signage

Various types of signage are proposed in the building block as per NBC 2016 Part -4. Material of signage shall be of acrylic / aluminium of required dimensions. At every floor near Lift landing diagram showing stairways shall be provided mentioning instruction- 'IN CASE OF FIRE, USE STAIRS UNLESS INSTRUCTED OTHERWISE'.

The signage shall be above call push button in Lift Lobby. Floor Signage will be provided in each floor within the staircase & should easily readable. Each corridor of every floor will have directional signage indicating Fire Escape Proposed route.

These Signage may be LED lit with UPS power backup or of photo Luminescent paint so that they can be visible even in dark in case of power failure.

Response indicator:

(i) The response indicator shall be used to locate a fire alarm if the detector's LED cannot be seen (i.e. it is hidden by false floors, false ceilings etc.). When a detector is set off, as well as the alarm message being sent, unit response indicator is also activated and flashes red.

(ii) The response indicator shall loop powered and separate power supply shall not be required.

(iii) Remote response indicator shall be installed outside the areas normally kept closed to identify the detector response even if the room is locked. These indicators shall be able to indicate the status of the corresponding detectors in these areas. 4.7.1 Installation of Response Indicator:-

(i) Response indicator shall be installed on wall such that its top is at door level and by the side of the entrance to the respective premises.

(ii) Response indicators for detectors installed over a false ceiling in a corridor shall be installed directly under the false ceiling.

(iii) Response indicators for detectors under a false floor shall be installed at a height of 1 mtr above false floor level. Additionally, a marking of an arrow pointing downwards shall be made by the side of the response indicator.

(iv) The installation shall be such that visual indications from the response indicators are conspicuous and the affected area is spotted without difficulty.

4.26. ELECTRICAL WORKS RELATED TO FIRE FIGHTING SYSTEM

Firefighting panel of suitable size incomer & sufficient numbers of outgoing feeders for all pumps along with spares/spaces shall be provided.

Power cabling of suitable size to be laid from LT panel to firefighting panel. Power cabling of suitable size from firefighting panel to fire pumps to be laid. Control cabling from fire pumps to firefighting panel &firefighting panel to pressure switch to be done.

Suspenders and/or cable trays for laying cables to be used for sprinkler system, fire annunciation panel needs to be considered. Motor shall be TEFC squirrel cage AC induction type. The motor shall be suitable for continuous duty & rating necessary to drive the pumpat150% of its rated discharge with at least 65% rated head. Motor shall be with class F insulation &1E-2 class efficiency. DOL/star delta starter shall be provided as per H.P rating of motors.

Adequate no. of NO/NC contacts for interlocks, indicating lamps, remote operation etc. shall be provided on starter/ contractor.

Metallic body of all motors, medium voltage equipment etc. shall be connected by 2 separate & distinct earth conductors to the earth stations of the installations. Looping of such body earth conductors is acceptable from one equipment to other equipment.

4.27. FIRE ALARM AND DETECTION SYSTEM (FAS)

Scope of Work:

The scope of FAS / AFAS installation work shall generally comprise the supply, installation, testing and commissioning of the following. The scope shall also include the engineering design of the system, using the equipment offered.

(i) Trigger devices viz. automatic fire detector of the required types and/or manual call boxes.

(ii) Sounders of low intensity and high intensity types.

(iii) Control and indicating panels including repeater panels, if any.

(iv) Standby battery and charging unit.

(v) Mimic diagram (s)

(vi) P.A. System.

(vii) System wiring.

General

a. The specifications includes furnishing, installation, connection and testing of the microprocessor controlled, intelligent reporting fire alarm network equipment required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, Network Fire Alarm Control Panels (FACP), Network Reporting Terminals (NRT), Network Liquid Crystal Display (NLCD), auxiliary control devices, annunciators, and wiring as specified herein.

b. The fire alarm system shall comply with requirements of IS:2189:1999 & 1996 NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification, or the stringent one of the two specification in case of any discrepancy. The system shall be electrically supervised and monitor the integrity of all conductors.

c. Fire Alarm System shall be integrated with P.A. system. A digitized pre-recorded voice message shall notify occupants that a fire condition has been reported. The message shall instruct the occupants with emergency instructions. Emergency manual voice override shall be provided.

d. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and shall be in compliance with the UL listing for equivalent European standard EN54.

e. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Alarm Control Room and designated personnel.

f. The FACPs shall be active/interrogative-type systems where each transponder is repetitively scanned, causing a signal to be transmitted to the fire alarm control panel node indicating that the transponder and its associated initiating device and notification appliance circuit wiring is functional. Loss of this signal at the FACP shall result in a trouble indication on both the FACP display and at the network display, as specified hereinafter for the particular input.

g. The system shall be arranged such that not less than 20 percent additional transponders may be inserted into any network communication loop.

h. The installing company shall employ technicians on site to guide the labours and to ensure the systems integrity.

Submittals

A. General: All substitute equipment proposed as equal to the equipment specified herein, shall meet or exceed the following standards. For equipment other than that specified, the Contractor shall supply proof that such substitute equipment does in fact equal or exceed the features, functions, performance, and quality of the specified equipment. Two copies of all submittals shall be submitted to the Engineer-in-charge/Engineer for review.

B. Shop Drawings: 1. sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications. 2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to point diagrams, and conduit layouts. 3. Show equipment layout and main control panel, module layout, configurations and terminations.

C. Approvals:

- The system must have proper listing and/or approval from the following nationally recognized agencies: UL Underwriters Laboratories Inc FM Factory Manual ULC Underwriters Laboratories Canada CPWD Central Public Work Department BIS Bureau of Indian Standards EN 54 or Equivalent European Standards

- The fire alarm control panel, network interface and all transponders shall meet the modular labeling requirements of Underwriters Laboratories, Inc. Each sub assembly, including all printed circuits, shall include the appropriate UL modular label. Systems which do not include modular labels, which may require return to the manufacturer for system upgrades, and are not acceptable.

4.28. FIRE ALARM CONTROL PANELS AND FIRE CONTROL ROOM:

The Fire Alarm Control Panel shall be as per Section 7.33 of IS: 2189. Each network FACP shall contain a microprocessor-based central processing unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable detectors, addressable modules, Panel modules including initiating circuit, control circuits, transponders, local and remote operator terminals, printers, annunciators, emergency voice communication systems, and other system controlled devices. Each FACP on the network shall perform the following functions:

a. It shall Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.

b. It shall supervise all initiating signaling and notification circuits throughout the facility by way of connection to monitor and control modules.

c. It shall detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.

d. It shall visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.

e. When a any of the following condition is detected and reported by one of the system initiating devices or appliances:

   i. Fire Alarm Conduits

   ii. Trouble Confirmation.

   iii. Supervisory Card

   iv. Security Alarm

   v. Pre Alarm Then the following functions shall immediately occur:

   a. The FACP alarm LED on the FACP shall flash.

   b. A local piezo electric indication for the event signal for the event in the FACP shall sound a distinctive Signal.

   c. The 640-character LCD display on the local FACP node and on the network displays shall indicate all information associated with the fire alarm condition, including the type of alarm point, and its location within the protected premises. This information shall also be displayed on the network reporting terminal.

   d. Printing and history storage equipment shall log the information associated with the fire alarm control panel condition, along with the time and date of occurrence.

   e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated on either local outputs or points located on other network nodes.

Type of control and indicating panels:

Following are the types of control and indication panels in Addressable Fire Alarm Control Panel:

(i) Intelligent Addressable Main Fire Alarm Control and Indicating Panel.
(ii) Graphical Fire Alarm Management System.
(iii) Intelligent Repeater Panel.
(iv) Intelligent Response Indicator
(v) Talk Back System / Fire Fighter Telephone Systems

Addressable Fire Alarm Control Panel (FACP)

1. The addressable Fire Alarm Control Panel (FACP) shall function as a network panel & also as a fully stand alone panel. FACP shall have its own microprocessor, software and memory. In the event of failure of panel or communication breakdown between the networked panels the FACP shall automatically operate on stand-alone mode without sacrificing any functions (The networking should be peer to peer).Information of all panel in the network should be available on all individual panels

2. The panel should be modular microprocessor based in nature and should be expandable from single loop up to 10 loops.

3. FACP shall supervise detection circuits and shall generate an alarm in case of abnormal conditions.

4. FACP shall provide general purpose inputs for monitoring such functions as low battery on AC power failure. FACP shall provide tamper protection and commandable outputs, which can operate relays or logic level devices.

5. Smoke detectors shall be powered using the FACP based smoke detection circuits FACP shall provide control for resetting smoke detectors, fault isolation and sensor loop operations. It shall be possible to mix different fire devices within same FACP to optimize field wiring.

6. It shall be possible for the panel to have a loop length with different modules offering 1.5 km length of devices from the panel.

7. FACP shall provide monitoring and control of one floor or area or for multiple floors or areas. FACP shall meet the following requirements to assure the integrity and reliability of the system:

   (a) The FACP shall have proper listing and / or approval from the following recognized agencies:

(I) National Fire Protection Association (NFPA) -USA. This will cover the following approval:

(i) UL (Under writers Laboratories Inc.)
(ii) ULC (Under writers Laboratories Canada)
(iii) FM (Factory Mutual)
(iv) CSFM (California State Fire Marshal)

(II) EN (European)
This will cover the following approval:

(i) LPCB (Loss Prevention Council Board)
(ii) VDS (Vertauen Durch Sicherheit)
(iii) BRE

FACP shall be NFPA/EN listed independently and as per relevant IS Code as a Fire Alarm Control Panel.

(b) The FACP should have integrated power distribution module and fixed cabling done internally to guarantee a clear and tidy cable feed

(c) The panel should have an LCD display with minimum 300 characters and keypad. The Display should enable a flexible design of the operating menu with variable keys and message windows fixed keys should be used for standard operating steps e.g. for fire alarm securities supervisory trouble and other events. The current status of the system should be displayed by LED's interfaces (RS232) enable the connection to a PC.

(d) The panel should have a 230V AC power supply unit in plug in design with rack and panel connector and 24VDC /6Amp. single output power supply. The module should be protected against over voltage and reverse polarity. The output voltage is monitored and regulated externally.

(e) LCD display at the FACP shall be provided to indicate point of alarm or trouble. In Such systems means for manually scanning the points in trouble shall be provided and a trouble and alarm LED shall be used to indicate that there are points in alarm / trouble. The alarm /trouble LED shall only get switched off when all alarm / trouble are cleared from the loop.

(f) It shall be possible to command test, reset and alarm silence from the FACP.

8. FACP switches shall allow authorized personnel to accomplish the following, independent of the central console.

(a) Acknowledge a general alarm condition.

(b) Silence the local audible alarm.

(c) It shall be possible to silence the alarm indicating devices (hooters).

(d) Reset all zones (logical Point Group) / points, after all initiating devices have returned to normal.

(e) Perform a complete operational test of the memory with a visual indication.condition of any zone (Logical Point Group).

(f) Test all panel LED's for proper operation without causing a change in the

(g) Walk test –The system shall provide both a basic and advanced walk test for testing the entire fire alarm system including testing of all devices, detectors module etc. in the complete system.

9. Software zones/loops shall be circuited and protected by fault isolators such that in the event of a zone/ loop short –circuit, smoke and thermal sensors shall be located and shall report alarm and fault isolator unit after every 20 detector or devices in a loop isolates the part.

10. Monitoring modules shall be provided to monitor and address contact-type input devices. The monitor module shall be housed in the FACP supervised by FACP.

11. The FACP shall have drift compensation facility to compensate for environment.When a detector accumulates dust in the chamber and reaches an unacceptable level but still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

12. The FACP should be NFPA/EN listed approved to provide the sensitivity measurement and documentation required.

13. FACP shall be backed up with its built in UPS power or can be powered separately.

14. The display on FACP shall provide indication for AC power, system alarm, system trouble/security alarm, display trouble and signal silence to this would mean that in the event of change of any detector/zone sequence alterations, the operator can initiate these by use of the LCD & alpha –numeric keys on the FACP panel to reconfigure the above parameters.

15. Power supply unit of FACP shall have following characters:

(a) The main power supply shall be 230V AC ±10% 50Hz ± 3% and shall in turn provide all necessary power of FACP.

(b) It shall provide a separate battery control module with charger. The battery should last for 24 hours minimum in normal operation upon power failure & 30minutes in alarm condition.

(c) For ease of service, all wiring terminal blocks shall be plug-in type.

(d) The fire alarm panels shall have a possibility of being interlinked by direct connectivity or an optical cable link between the various locations and should further have connectivity to the main control center.

16. Each loop shall have minimum 99 detectors/devices.
17. There shall be minimum 20% spare capacity in the looping system for future expansions. The firm has to intimate the maximum number of devices/ detectors can be connected in one loop based on the manufacturer design . Some devices need external supply and some devices supported by loop power.
18. The length of loop shall not exceed more than 3000 meter for wire size 1.5sq mm. as per manufacturer recommendations.
19. Each loop should not be divided into more than 8 fire zones.

Graphical Fire alarm management system

(i) The fire alarm management system shall be a multi user graphical management system to centrally monitor and operate the fire alarm system by a computer having a graphical software.

(ii) All the messages and status of the connected detectors & devices with main control panel shall be displayed on the PC monitor to operate via keyboard and mouse. All devices & detectors should be visible on building plans superimposed in fire alarm system.

(iii) The modular expansion of the system should be possible by adding software modules.

(iv) Power graphics with a dynamic zoom function should be available.

(v) The system shall have password system with individual password and access privileges shall also be available.

(vi) The system should be capable monitoring status of detector. The status of each detector be monitored by the fire alarm system.

(vii) The operator should be able to adjust the sensitivity of any detector.

(viii) The operator should be able to define the entire database for the fire system.

(ix) The operator should be able to acknowledge alarm or trouble messages by the fire alarm system.

Intelligent Repeater Panel

(i) The repeater panel shall be active repeater panel with all the controls and monitoring as on the main fire alarm panel.

(ii) The panel shall be functioning as a controller.

(iii) The panel shall allow remote command in the system reset, trouble and alarm silence and manual alarm.

(iv) A keyed switch shall enable or disable the keys.

(v) The panel shall be compatible with the analog fire detection and alarm main control panel.

(vi) It shall be programmable to display information for the entire system i.e. all panels in the network.

(vii) It shall have minimum 80 characters LCD display (display system status). The back lit display repeats the status, trouble and alarm messages displayed at the fire detection and alarm panel in English text.

(viii) The system text displays shall include: Alarm missing point trouble; system test, service, local system test, extra custom test by polling circuit and address.

(ix) It shall have an internal trouble buzzer .

(x) It shall be possible to connect up to 4 repeater panels with each fire detection & alarm panel.

(xi) It shall annunciate alarm and trouble conditions.

Application:

The repeater panel can be installed in the guard rooms/security room at the entrance of a building or complex which may have one or more buildings so that in case of emergency the security personnel can rush straight to the trouble point.

Installation requirement of repeater panel:

(i) No panel or management system shall be located inside any room the building or in a room of severe environment conditions.

(ii) The panel shall be positioned in “Fire Alarm Control Room” in a building or any other conspicuously sited location so as to be visible without effort on entering a building and as per the drawing approval by the department /consultant architect.

(iii) The panel shall be either wall mounted or floor mounted.

4.29. SYSTEM COMPONENTS - ADDRESSABLE DEVICES DETECTORS & ADDRESSABLE DEVICES

The addressable detector and devices shall comply to the below mentioned specifications. The addressing of detectors and devices shall be of rotary type electronic addressing shall not be acceptable.

Intelligent Laser Photo Smoke Detector

a) The intelligent laser photo smoke detector shall be a spot type detector that incorporates an extremely bright laser diode and an integral lens that focuses

the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.

b) The laser detector shall have conductive plastic so that dust accumulation is reduced significantly. c) The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.03 percent per foot.

d) The laser detector shall not require expensive conduit, special fittings or PVC pipe.

e) The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases. f) The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required. g) The laser photo detector shall include two bi-color LED that flash green in normal operation and turn on steady red in alarm.

Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.

- If a wire-to-wire short occurs, the isolator module shall automatically open circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
- The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
- The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
- The isolator module shall not consume any detector or device address from the loop capacity.
- **Intelligent Multi Criteria Acclimating Detector.**
- a) The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.

- b) The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
- c) The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena. Intelligent Thermal Detectors Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.
- **Intelligent Photoelectric Smoke Detector**
- The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Intelligent Multi Sensor intelligent Detector (CO, IR, Smoke & Heat)
- a) The intelligent multi sensor intelligent detector shall be an addressable device that is designed to monitor a minimum of photoelectric, thermal technologies, carbon monoxide & infrared in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
- b) The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, parking etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes) The intelligent multi sensor detection device shall include the ability to combine the all of four signals in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.

Photo Thermal Multi - criteria Detector

This detector combines optical smoke and heat detection and is capable of being used as a smoke and Heat Detector both. The multi criteria detector shall be able to discriminate between non-threatening deceptive phenomenon such as cigarette smoke and actual fire hazards. This avoids nuisance alarm. Application: This is good for smoldering and fast flaming fires, Optically dense smoke and can be used in buildings for AC and Non- AC Area

Addressable Beam Detector (Infra-red light Detector)

1. The Beam Detectors shall be long range, projected beam type smoke detectors which consist of a separate transmitter and receiver and evaluating unit Integrated in to a compact Housing.

2. The transmitter shall emit an invisible pulsed infra red beam to receiver when beam is obscured beyond selected threshold (20%, 30%,…….70% obscuration) by smoke, the receiver shall signal a trouble.

3. It shall provide selectable sensitivity and alarm response time for flexibility of Installations.

4. It shall have a range coverage from 9 mtrs to 100 mtrs. With up to 16-17 mtrs. Spacing between adjacent detectors on smooth, flat ceilings.

5. It shall have automatic environment compensation.

Intelligent Duct Smoke Detector

a) The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

b) When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

- Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
- If a wire-to-wire short occurs, the isolator module shall automatically open circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.

- The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
- The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.
- The isolator module shall not consume any detector or device address from the loop capacity.

Intelligent Addressable Monitor Module

(i) The module shall be suitable to monitor the polling of up to minimum four potential free contacts by using a single or multiple housing and designed for surface or flush mounting.

(ii) The operating mode can be selected and is assigned separately for each input the addressing of the module and the setting of parameters should be carried out using PC software, via the fire alarm control panel.

(iii) The module should contain an integrated short circuit isolator which ensures that the fault is localized and the loop continues to function fully in the event of a wire break or a short circuit.

(iv) The module should be minimum IP 40 protection category when housed in a case or as per manufacturer design.

(v) The module should be with soft addressing to be set with a PC via fire alarm panel at the time of programming.

(vi) The module should have integrated buzzer force signaling maintenance alarms.

(vii) An LED shall be provided that shall flash under normal condition indicate that module is operational.

Talk Back System/Fire Fighters Telephone Systems:-

(i) Fire Fighters Telephone System Panel:- Fire Fighters Telephone System Panel shall be microprocessor based with its own micro controller, memory, communication modules, intelligent initiating and indicating devices and suitable SMPS. The panel shall be suitable for required number talk back unit connections. The fire fighters telephone system will have integral talk back system to provide a 2 way voice communication between the fire fighters telephone. The talk back system shall include fire fighter master control console with a back lit LCD display for status display and a fire fighters telephone handset, standby battery for 24 hours in operation and half an hour alarm condition. The Fire Fighter Telephone System shall also include the following: A red colored master telephone handset with flexible coiled self

winding five feet cord placed within the fire fighters telephone system panel housing:-

(ii) The Fire Fighters Telephone Systems Panel shall include:-

(iii) - Indicating High power LED - Input power supply : 230 volts AC 50Hz single phase supply 17-28V DC through rectifier, sealed maintenance free battery including trickle/Booster battery charger. Fire fighters telephone system panel housing shall be Dust and vermin proof cold rolled steel sheet 16 gauge powder coated with see through glass 0 0 front Fire fighters Telephone system shall be able to withstand 10 to 490 C and up to 93 % RH non condensing type. Fire fighter Telephone system shall be able to be integrated with building and control system and Public Address System.

(iv) Talk back Units/Fire Fighters Telephone:-
Red Colored fire fighters telephone of rugged ABS plastic construction with 1500mm coiled cord, a hook switch and the telephone jack placed in a surface mounted cabinet of 18 gauge CRC sheet steel construction with a hinged lockable door and a break glass full front panel labeled. Fire Fighters Telephone including painting with two coats of red synthetic enamel paint over one coat of primer.

Addressable Control Relay Module.

Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires. Addressable Control Module

a) Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered polarized audio/visual notification appliances.

b) The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistve A/V signal operation.

c) Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.

d) The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

Intelligent Addressable Monitor Module

a) The module shall be suitable to monitor the polling of up to minimum four potential free contacts by using a single or multiple housing and designed for surface or flush mounting.

b) The Operating mode can be selected and is assigned separately for each input the addressing of the module and the setting of parameters should be carried out using PC software, via the fire alarm control panel.

c) The module should contain an integrated short circuit isolator which ensures that he fault is localized and the loop continues to function fully in the event of a wire break or a short circuit.

d) The module should be minimum IP 40 protection category when housed in a case or as per manufacturer design.

e) The module should be with soft addressing to be set with a PC Via fire alarm panel at the time of programming.

f) The module should have integrated buzzer force signaling maintenance alarms.

g) An LED shall be provided that shall flash under normal condition indicate that module is operational.

Manual Pull Stations

The fire alarm station shall be of poly carbonate construction and incorporate an internal toggle switch. A locked test feature shall be provided. The station shall be finished in red with silver "PULL IN CASE OF FIRE" lettering. Programmable Electronic Exit Point Directional Sounders with Strobe Light

a) Shall follow NFPA 72 2007 edition recommendation.

b) Electronic sounders shall operate on 24 VDC nominal.

c) Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.

d) Shall be capable to broadcast pre programmed Voice Message also

e) Shall be flush or surface mounted as shown on plans.

f) Shall produce broad band directional sound with 20 Hz to 20 KHz frequency band to guide occupants to safe exists even in complete darkness.

g) Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:

h) The maximum pulse duration shall be 2/10 of one second.

i) Strobe intensity shall meet the requirements of UL 1971.

j) The flash rate shall meet the requirements of UL 1971.

k) Field Wiring Terminal Blocks l) For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

Test

The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system.

a. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
b. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
c. Verify activation of all flow switches.
d. Open initiating device circuits and verify that the trouble signal actuates. e. Open signaling line circuits and verify that the trouble signal actuates.

Intelligent Addressable Relay / Control Module

- Relay module may contain up to four relays each with a potential free changeover contact.
- Each relay contact should be FAIL/ SAFE programmable, means it should be possible to program each contact to operate in three conditions viz. NO FIRE CONDITION, FIRE CONDITION AND LOOP POWER FAILURE CONDITION.
- Both the addressing of the module and setting of parameters to be carried out using PC software via the fire alarm control panel.
- The module contains a short circuit isolator, which ensures that the fault is localized and that the loop continues to function fully in the event of a wire break or a shot circuit.
- The module should be minimum with IP 40 protection category when housed in a case or as per manufacture design.
- It should have integrated buzzer for signaling maintenance alarms.

Manual Call Point

Scope

This section covers the requirements of manual call points (MCP) used in addressable intelligent fire alarm systems.

Constructional requirements of:-

i. It is used to trigger a fire alarm manually, and should be suitable for connection to the system loop technology. The alarm is raised by breaking the glass with

the alarm carrying on until a replacement glass panel is fitted or alarm to be made silent from control panel. Suitable arrangement like scratching by a diamond bit shall be incorporated in the frangible element.

ii. A micro switch within the units is held “off” by the edge of the glass when glass is broken the switch is released and a signal is transmitted to control panel where the alarm is raised. The glass is preferably plastic coated to eliminate the damage of splinters causing injury.

iii. For testing without breaking the glass a test key, should be available so as to lower or remove the glass to release the micro switch. Full functional test is achieved accordingly.

iv. Facility for reset/adjustment of manual call point alarm triggering.

v. The unit shall be made out of poly carbonate ABS blend with flame retardant & self extinguishing properties or cast aluminum or ASA plastic or as per manufacturer design and applicable standards.

vi. It shall preferably contain an integrated short circuit isolator which should ensure that a fault is localized and that the loop continues to function fully in the event of a wire break or a short circuit.

vii. The call box shall have suitable provision to knock out of termination of a 20mm conduit. This shall also have suitable provision for being fixed on surface or semi recessed in wall.

viii. The word 'FIRE' shall appear embossed in red color on the front.

ix. Acknowledgment LED displays –red for triggered alarm indication (flashing) and / or maintenance evacuation.

x. Protective category shall be IP54 for indoors & IP65 for outdoors applications.

Sounders

(i) The frequency of sound from sounders shall lie in the 500-1000 Hz band. The sound level shall be at least 65dB (A) or 5dB (a) above or any other noise likely persists for a period longer than 30 second at any part of the building sounders with a level greater than 120 dB (A) shall not be provided.

(ii) The sound shall be continuous although the frequencies and amplitude may vary and of the same characteristics from the fire alarm sounders in a building. Coded fire alarm signaling from sounders shall not be provided which may cause hearing damage.

(iii) 'Fault alarm' and 'Fire alarm' in a panel sounder shall be distinctly different.

(iv) The sounder shall be with IP 54 protection category.

(v) It shall conform to EN/NFPA/Indian standards.

(vi) The volume of sounders can be adjusted from the fire detectors control panel. Minimum three volume setting from fire alarm control panel shall be available.

(vii) The strobe cum hooter are two wire devices that offer tone choices of either continuous horn or temporal tone when constant voltage from fire alarm control panel is applied. Each tone has minimum three volume levels that can be selected for installation.

(viii) The strobe cum hooter installed at entrance of building should have three tones programmable from the fire detector control panel so that at least one of these tones can be selected to comply with at least 110dB (A) frequency range of 440Hz to 2850 Hz. The Volume should be adjustable from control panel.

(ix) The strobe should have a light intensity from 15 cd to 110 cd.

4.30. FIRE, SPRINKLER AND JOCKEY PUMPS ELECTRIC DRIVE AND DIESEL ENGINE

Pump House: -

For installation of firefighting pumps (Main Electrical Pump, Diesel Engine Driven and Pressurization Pump) along with Electrical & Control Panel, valves, diesel tank etc., pump house is required. Following factors are considered:

- In order to provide positive (flooded) suction to fire pumps, the pump house shall be at a level below or equal to that of static water storage tank.
- The pump house at ground level shall be easily accessible for firefighting operations and at least 6 meters away from all surrounding buildings and overhead structures. In case, the 6m spacing of pump room from surrounding buildings is not feasible, the provisions of Para 5.1.12 of IS 13039:2014 shall be followed.
- General water supply pumps can be installed in the same pump house.
- Suitable ramp with proper slope and/or cutout in roof shall be provided for lowering the equipment in to the pump house. Stair case with entry door at ground level and locking arrangement shall be provided.
- In order to ensure that there is no leakage of water in the pump house, no pipe/ cable shall cross the pump house below ground level. Suitable opening in wall above ground level shall be provided for crossing of pipes/cables.
- Installation of negative suction arrangement and submersible pumps shall not be allowed.
- Pump house shall be separated by fire walls all around and doors shall be protected by fire doors (120 min rating).
- The pump house shall be clearly marked by luminous sign.

Pumping Sets

a) All pumps (main sprinkler & hydrant pumps, jockey pumps, diesel driven pump) shall be of suitable capacity & head to meet the requirements of NBC 2016 .

b) Pumping sets shall be multi stage horizontal split casing centrifugal Pump having single outlet with cast iron body and bronze dynamically balanced impellers. Connecting shaft shall be stainless steel with bronze sleeve and grease- lubricated bearings. The centrifugal pumps shall conforming to IS 1520.

c) Pumps shall be connected to the drive by means of spacer type love joy couplings, which shall be individually balanced.

d) The coupling joining the prime movers with the pump shall be provided with a sheet metal guard. Pump and motor engine shall be mounted on a common base plate fabricated from MS section.

e) Pumps shall be provided with approved type of mechanical seals.

f) Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut off head shall not exceed 120% of the rated head.

g) The pump shall meet the requirements of N.B.C. 2016 and N.F.P.A. and the unit shall be design proven in fire protection services.

h) Suction and delivery pipes of pumps shall not be less than following.

Pump Discharge	Suction dia (mm)	Delivery dia (mm)
(a) 2280 lpm	200	150
(b) 1620 lpm	200	150

Electric Drive Pump

- Electrically driven pumps shall be provided with totally enclosed fan ventilated induction motors of efficiency rating IE-3. For fire pumps the motors should be rated not to draw starting current more than 3 times normal running current
- The fire pump shall be horizontal end suction centrifugal type. It shall have a capacity to deliver 2280 LPM as specified in the BOQ, developing adequate head so as to ensure a minimum pressure of 3 kg. per sq.cm at the highest and the farthest outlet. The delivery pressure at pump outlet shall be not less than 6 kg. per sq.cm. in any case
- Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- Motors shall be wound for class F insulation and winding shall be vacuum

impregnated with heat and moisture resistant varnish glass fiber insulated.

- Motors for fire pumps shall meet all requirements and specifications of N.B.C.-2016 and N.F.P.A.
- Motors shall be suitable for 415 volts, 3 phase 50 cycles A/c supply and shall be designed for 38 deg. C ambient temperature. Motors shall conform to I.S. 325.
- Motors shall be designed for two-start system.
- Motors shall be capable of handling the required starting torque of the pumps.
- Contractor shall provide inbuilt heating arrangements for the motors for main pumps to ensure that motor windings shall remain dry.
- Speed of the motors shall be compatible with the speed of the pump.

Accessories

Each pump shall be provided with the following accessories: -

(a) Sluice valves on suction and delivery.

(b) Reducers, as may be required to match the sizes of the connected pipe work.

(c) Non-return valve at the delivery.

(d) Pressure gauge at delivery side between pump and the non-return valve.

(e) Flexible coupling/connections shall be provided between Pump sets and Valves on suction and delivery sides of all the pump sets.

Note: 1) No butterfly valves shall be installed inside the pump room.

2) The size of the non-return valve and cut off (Sluice valve) shall not be less than the size of the initial delivery pipe.

Installation

- Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations. Angle iron frame of size 35mmx35mmx3mm shall be provided on the edge of foundation.
- Pumps and motors shall be truly aligned by suitable instruments.
- All pumps connections shall be standard flanged type with appropriate number of bolts. In case of non-standard flanges companion flanges shall be provided with the pumps.
- Manufacturer’s instructions regarding installation, connections and commissioning shall be followed with respect to all pumps and accessories.
- Contractor shall provide necessary test certificates and performance charts with NPSH requirement of the pumps from the manufacturer.

- The Contractor shall provide facilities to The Engineer or their authorized representative for inspection of equipment dung manufacturing and also to witness various tests at the manufacturer's works without any cost to the HITES.
- Each pump shall be provided with a 150 mm dia pressure gauge, isolation cock and connecting piping, bleed and block valve.
- Provide vibration eliminating pad and connectors for each pump.
- A minimum clearance of 1M around the pumps shall be provided.

Vibration Eliminators

- Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors (double arch of min. PN 16 rating).
- Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connector shall be as per manufacturer's details.

Diesel Engine Pump

a) Diesel engine shall be of multi cylinders (4/6 cylinder AS PER REQUIREMENTS) with individual head assemblies. The engine shall be water-cooled and shall include heat exchanger/radiator cooled and connecting piping, strainer, isolating and pressure reducing valves, bypass line complete in all respects.

b) Engineer shall be direct injection type with low noise and exhaust emission levels and shall conform to BS649/IS 1601/IS10002 as amended up to date.

c) The speed of the engine shall match the pump speed for direct drive.

d) The engine shall be capable of being started without the use of wicks, cartridge heater, plugs or either at engine room temperature of 7 deg. C and shall take full load within 15 seconds from the receipt of the signal to start.

e) Noise level of the engine shall not exceed 105 DBA (free field sound pressure) at 3 m distance.

f) The engine shall be self starting type up to 4 deg. C and shall be provided with one 24 V heavy duty DC battery, starter, cut-out, battery leads complete in all respects. One additional spare battery shall be provided.

The battery shall have a capacity of 180 to 200 ampere hours and 640 amps cold cranking amperage.

- Provided a battery recharger of 10 to 15 amperes capacity with trickle and booster charging facility and regulator.
- Annunciation panel shall be suitable for working on 24 volts D.C.

Arrangement for starting shall be automatic on receiving the signal but shutting off shall be manual.

- The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer's design.
- Engine shall be suitable for running on high speed diesel oil.
- The system shall be provided with a control panel with push button starting arrangement also and wired to operate the engine on a differential pressure gauge.
- The entire system shall be mounted on a common structural base plate with ant vibration mountings and flexible connections on the suction and delivery piping.
- Provide one fully mounted and supported day oil tank fabricated from 5mm thick M.S. sheet electrically welded Provide level indicating gauge glass on the day oil tank and low fuel indication of the control panel. The capacity of tank should be sufficient to allow engine to run on full load for at least 2 hours. The fuel pipe from diesel tank to pump should be of robust construction, preferably of hard rubber.
- Provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gases to outside open air as per site conditions. The piping shall be duly insulated with 50mm thick glass wool and 1.0mm thick aluminium sheet cladding.
- Provide all accessories fittings and fixtures necessary and required for a complete operating engine set.

Cooling System

The engine shall be radiator water cooled. The radiator assembly shall be mounted on the engine. The radiator fan shall be driven by the engine as its auxiliary with multiple fan belts. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

Fuel System

The fuel system shall be gravity fed from the fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either adjacent to the engine or suitably wall mounted on brackets. The fuel filter shall be suitably located to permit easy servicing.

The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to Appendix 36 the engine.

Any valve in the fuel feed pipe between the fuel tank and the engine shall be placed adjacent to the tank and it shall be locked in the open position.

All fuel tubing to the engine shall be with M.S.'C' class pipe with flexible hose connections where required. Pipe joints shall not be soldered and plastic tubing shall not be used.

The following shall be provided:

i) A sludge and sediment trap shall be provided.

ii) An inspection and cleaning hole

iii) Means to enable the entire fuel system to be bled of air (Air relief cocks are not allowed; screwed plugs are permitted

Lubricating Oil System

Forced feed lubricating Oil system shall be employed for positive lubrication. Necessary lubricating oil filters shall be provided, located suitably for convenient servicing.

Starting System

The starting system shall comprise of necessary batteries 12 Volts/ 24 Volts, starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Suitable protection to protect starting motor from excessively long cranking runs shall be suitably integrated with engine protection system.

Exhaust System

The exhaust system shall be complete with residential grade silencer suitable for outdoor installation and silencer piping shall be extended up to 1 m, outside pump house duly insulated with 50 mm thick glass wool and 1.0 mm thick aluminum sheet cladding.

Engine shut down mechanism

This shall be manually operated and shall return automatically to the starting position after use.

Governing System

The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

An over speed shutdown device to shutdown the engine at a speed approximately 20% above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

Battery Charger

Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

The following spare parts shall be supplied with the engine and kept on hand:

a) Two sets of fuel filters, elements and seals;

b) Two sets of lubricating oil filters, elements and seals;

c) Two sets of belts (where used);

d) One complete set of engine-joints, gaskets and hoses;

e) Two injector nozzles;

f) One complete set of piston rings for each cylinder; and g) One inlet valve and one exhaust valve).

Pipe work

All pipe lines with fittings and accessories required shall be provided for fuel oil, lubricant oil and exhaust systems. The fuel tubing to the engine shall be MS C – class pipe with flexible hose connections wherever required.

4.31. OPERATING CONDITIONS FOR JOCKEY ,ELECTRIC& DIESEL PUMPS

- Jockey pump shall start automatically when the Water Pressure in the System falls to a pre-set value and shut down when the system pressure reaches the set value. Both Limits shall be adjustable. The Pressure switch settings for Jockey Pump shall be determined as per relevant codes and Site Conditions.
- Main Electric Fire Pump shall operate on account of sudden pressure loss. So, long as Main Electric Fire Pump is working, other Fire Pumps will not operate. The Pump shall start when the water pressure falls to a pre-set value in the system The Pressure switch settings for Jockey Pump shall be determined as per relevant codes and Site Conditions.
- The Diesel Fire Pump will start on sudden pressure loss, only in case supply to main electric Fire Pump is not available or within a pre-set time the main Electric Fire Pump fails to start or fails during operation. No other pump will be working when Diesel Engine fire Pump is in operation. Audio-Visual Alarm shall be available to indicate failure of Main Electric Fire Pump.
- A three attempts starting facility will be provided for diesel Pump.
- If within a pre-set time, the pump also fails to start or fails to develop pressure, the diesel pump shall also be shut down and locked out. An audio visual alarm indication shall be given at the Control Panel.

- The Terrace Pump will start on sudden pressure loss of pressure only when both the Fire Pumps have either failed to start or exhausted water.
- Only one pump will be working at a time. In manual mode, more than one Pump can be started.
- Water Level in UG and Terrace Tanks shall be monitored and in case of low water level, pumps connected with the tank shall not operate (even on manual mode) or stop operation as the case may be. An audio-visual alarm shall be given at the Control Panel. The Terrace Fire Tank shall be provided with Baffles to ensure proper circulation of water before overflow/discharge into domestic tank.

VIBRATION ELIMINATORS

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connector shall be as per manufacturer's details.

Pump channels shall be provided with min. one coat of black paint.

AIR VESSEL FOR FIRE PUMPS

Air vessel shall be fabricated out of 8 mm thick MS sheet & the end shall be dished and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 40mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. The vessel shall be 250mmx1200mm dia high and tested at 25 Kg/cm2 pressure before installation. The fire pumps shall operate on drop pressure in the mains automatically or manually. (The ratings will be adjusted finally at the time of commissioning as per site requirement and final setting shall be kept as per approval of Engineer-in-Charge).

4.32. ELECTRICAL INSTALLATIONS

Power And Control Panel And Other Control Components

For Fire Fighting Panel & Control Panel, specifications under Technical

Specifications for LT Panel under Electrification shall be followed.

Cable Laying:

Cable shall be laid generally in accordance with CPWD Specifications (Electrical) External & Internal amended up to date. Cables shall be laid on 14 gauge perforated MS sheet cable trays and cable drops/risers shall be fixed to ladder type cable trays fabricated out of steel angle. Access to all cables shall be provided to allow cable withdrawal/ replacement in the future.

Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity. Cables shall be suitably supported with Galvanized saddles when run on walls/trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks, tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable 1.1 KV cable shall be buried 600 mm below ground level. For additional details pertaining to Cable Laying, Refer the Electrical Works Specifications under the relevant Head.

Wire Sizes:

For all Single phase/ Three phase wiring, 1100 volts grade PVC insulated copper conductor wires shall be used. The equipment inside plant room and AHU room shall be connected to the control panel by means of insulated aluminum conductor wires of adequate size. An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated single strand aluminum conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification in control wiring.

The minimum size of control wiring shall be IS marked 2.5 mm2 PVC insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.

Power wiring cabling shall be of the following sizes:

e. Up to 5 HP motors: - 3 x 4 mm2 Cu conductor wires.
f. Above 5HP up to 15 HP motors: - 2 Nos. 3 x 6 mm2 Cu conductor wires.
g. From 20 HP to 25 HP motors :- 2 Nos. 3 x 10 mm2 Al conductor armoured cables.
h. From 60 HP to 75 HP motors. :- 2 Nos.3 x 50 mm2 Al conductor armoured cables.
i. 100 HP motors. :- 1 No. 3 x 150 mm2 Al conductor armoured cables.

All the switches, contractors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The following capacity contractors and overload relays shall be provided for different capacity motors.

The motor starter shall conform to IS 1822 as amended up to date.

Earthing:

For Earthing details, Refer the CPWD Electrical Works Specifications 2013and electrical specification.

Drawings:

Shop drawings for control panels and wiring of equipment showing the route of conduit/ cable shall be submitted by the Contractor for approval of The Engineer before starting the fabrication of panel and starting the work. On completion, four sets of complete "As-installed" drawings incorporating all details like, conduits routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

Testing:

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS Codes and test report furnished by a qualified and authorized person. The entire electrical installation shall be got approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Supervisor.

Painting:

All sheet steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be backed in an oven. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

Label and Tags

Engraved PVC labels shall be provided on all incoming and outgoing feeders' switches. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel and covered with transparent plastic sheet. All cables terminations at panels and at equipment shall be provided with tags as approved by Project Manager.

1. All panels to have provision for padlocking and all MCCB's/ MCB are to have provision for locking in off position.

Power Cabling

(i) Unless otherwise specified, the power cables shall be XLPE insulated, PVC outer heathed aluminum conductor, armoured cables 1100 V grade. The power cables shall be of 2 core for single phase, 4 core for sizes up to and including 25 sq.mm for 3 phase and 3-1/2 core for sizes higher than 25sq.mm for 3 phase. Alternatively, XLPE/PVC insulated copper cable (single core/multi core armoured / un-armoured) of grade 1100 V shall be used. For main power cable(s) from LT Room to Fire Pumps Panel, if the cable(s) is taken in cable trench duly filled with sand & with proper distancing from other cables within the cable trench, or in fire rated shaft, then the cable(s) of above type be used. However, if the cable(s) is likely to be exposed to fire,then fire survival cable(s) shall be used.

(ii) Power cables shall be of sizes to meet the starting and running current of motors fed and shall be as approved by the Engineer-in-Charge, after taking into consideration the load, the length of cabling.

(iii) Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls. Cable ducts shall not be provided in pump rooms. Cable trays shall be of perforated steel sheet with adequate structural strength and rigidity. Necessary supports and suspenders for cable trays shall be provided by the contractor as required.

Supplying and fixing of following sizes of STEEL conduit along with the accessories in surface/recess including painting in case of surface conduit, or cutting the wall and making good the same in case of recessed conduit as required.

Control Wiring

(i) Control wiring shall be done using ISI marked PVC insulated and PVC sheathed, 2.5 sq.mm, 250 V grade, armoured multi-core copper conductor cable. The control cable shall also be laid in the same manner as power cable.

(ii) The number and size of the control cables shall be such as to suit the control system design adopted by the contractor.

(iii) Runs of control wires within the-switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.

(iv) Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.

Earthing

(i) Provision of earth electrodes and the type of earthing shall be as specified in the tender specifications.

(ii) The earth work shall be carried out in conformity with CPWD Specifications for Electrical works (Part-I), Internal 2013.

(iii) Metallic body of all motors, medium voltage equipment and switch boards shall be connected by two separate and distinct earth conductors to the earth stations of the installations. Looping of such body earth conductors is acceptable from one equipment, or switch board to another.

(iv) The size of earth conductors for body earthing of equipment shall be 2 Nos. 6 mm dia copper wire/2 Nos. 25 x 5 mm G.I. strip.

(v) Armoring of cables shall be connected to the body of the equipment/switch board at both the ends. Compression type glands shall be used for all such terminations in the case of **PVC/XLPE cables.**

(vi) Earthing with G.I. earth plate 600mm x 600mm x 6mm thick including accessories, and proving masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 meter long etc. with charcoal/ coke and salt as required.

10.12 PAINTING

All panels shall be supplied with the manufacturer's standard finish painting or as indicated in the Schedule of Work

Insulation Mats

A. Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

B. Insulating Mat Class-B. 2.5mm Thickness x 1mtr width, Working Voltage: Up TO 11kv, AC Proof Voltage : 22KV, Dielectric Strength: 45 KV as per IS:15652-2006 ISI marked, Color: Black

C. Supply and fixing in position 1m wide insulation mat made of elastomeric polymers material (Class - A) of 415V grade as per IS 15642-2006. Thickness of insulation mat shall be not less than 2mm to withstand 1.1 KV dielectric strength as per IS 15652:2006. It should be complete as per specifications and directions of Engineer-in-charge.

4.33. ELECTRIC FIRE PUMP PANEL : -

The main switch board shall be floor mounted/ wall mounted fabricated from 2mm thick CRCA sheet powder coated with IP 42 protection 3Ph 415V Normal supply for fire pumps near UG tank and Essential supply for terrace pump and jockey pumps

The panel shall incorporate the following facilities.

a. TP &N Moulded case circuit breaker of appropriate fault level

b. Control system components and equipment such as relays, Contractors, and timers etc. for automatic operation.

c. Starter unit, current transformer and ammeter

d. Indication lamps, their fuses, terminal block, push button, control and selector switches etc. as required.

e. Pump lock out devices due to faults or abnormalities as specified.

f. Visual/ audio alarms, indications and communications facility as specified.

g. Necessary inter-connection control and power cable work, cable glands, lungs and internal wiring and connections.

Engine Section: -

The engine section shall incorporate the following facilities.

a) Control system components and equipment such as relays, Contractors, and timers etc. for automatic operation.

b) Instruments, indicator lamps, fuses, terminal blocks, push buttons, control and selector switches etc. as are required.

c) Engine shut down and block out devices due to faults or abnormalities as specified.

d) Visual/ audio alarm indication and enunciator facility as specified.

e) Inter- connection control and power cable work, cable glands, lungs, all internal wiring and connection etc.

Auxiliary Pump Section: -

Each of the auxiliary pump section for priming pump shall incorporate the following:

a) TP&N Molded case circuit breaker

b) Control system components such as relays, timers, Contractors etc. as are necessary for functional requirements.

c) Starter unit, current transformer and ammeter

d) Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.

e) Inter-connections, power and control cable work, cable plants lugs, internal wiring and connections.

f) Low water level alarm for terrace tank, where provided.

System Controller: -

The system controller shall consist of relay timer, contractor etc for interlocking of fire pump and fault isolation and incorporate the following:

a) Control components integrating the various sections, so as to satisfy the functional requirements.

b) Battery charger unit with boost/ float charge facility with voltmeter, capable of independently charging 1 set of battery at a time.

c) Visual/ audio alarms not covered in individual sections.

d) Lamps healthy test facility.

e) Instruments, indicating lamps, push buttons, fuse terminal blocks etc. as are required.

f) Test facility to stimulate operation of hydrants.

Other Control Components

Pressure Switches:

Pressure switches shall be provided for switching on and off the jockey pump at present pressures and also for switching of the fire pump at priest pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure switches shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

Low water level indication and switch:

To prevent the dry running of the fire pumps due emptying of the static tank, water level indication and switch shall be provided. This shall trip the electric motor or stop the diesel engine, as the case may be when the water level goes below a present level. This shall also furnish a distinct low water level audiovisual alarm. This should indicate the level of water at different stages is the power and control panel.

Power Supply for Controls:

In order ensure that the control systems remains operational at all times, the control system shall be designed for 24V DC operation, fed from 24 V wet battery. This shall be independent of the starting battery for the engine i.e., battery shall remain trickle charged at the times from the common battery, charges at the control section.

Operating Conditions For The Fire Pumps :

Fire Service Pump	Nos	Cut in Pressure	Cut out pressure	Remarks
Jockey Pump	Two	Automatic	Automatic	To auto start and stop
Main Pump (Hydrant)	One	Automatic	Push button Manual	To auto start on pressure switch on air vessel and manual off
Sprinkler Pump	One	Automatic	Push button Manual	To auto start on pressure switch on air vessel and manual off
Diesel Fire Pump	One	Automatic	Push button Manual	To auto start on pressure switch on air vessel and manual off

Submittal by contractor / fire stops applicator

The fire stop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration and joint location on the entire project.

The Documentation form for through penetrations is to include:

1. A sequential location number
2. The project name
3. Date of installation
4. Detailed description of the penetration's location
5. Tested system or engineered judgment number
6. Type of assembly penetrated
7. A detailed description of the size and type of penetrating item
8. Size of opening
9. Number of sides of assemblies addressed
10. Hourly rating to be achieved

Items which are not mentioned in list but required at site, can be taken from the approved list of Approved make of PWD Assam etc. Furthermore, the materials/equipment to be used which are not mentioned in any of the below list should have ISI or equivalent it shall be Certified from the engineer in charge during execution.

ELECTRICAL WORK

TECHNICAL SPECIFICATION FOR ELECTRICAL SYSTEM

ELECTRICAL SYSTEM

5.1. GENERAL

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. 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 General Specifications amended upto date.

Part-I - Internal Work - 2023.

Part-IV - Substation Work- 2013.

Part-VII - DG Set Work - 2013.

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.

The details of scope of work subhead wise are given in the subsequent phrase.

The Contractor should note that the specifications furnished general nature only and it is the responsibility of the Contractor to design, supply, install and commission the equipment and services required for the satisfactory performance of the installation. All the items of equipment required for the safe and satisfactory operation of the installation shall be supplied and installed by the Contractor.

5.2. SCOPE

This specification covers the technical requirements of design, test at manufacturer's works, Supply, Testing and Commissioning of Electrical Work complete with transit insurance, transport, unloading at site, assistance for testing, commissioning and erection & all accessories for efficient and trouble-free operation. The manufacturer must have carried out installation based in Assam state with proven performance under Assam climatic condition (an altitude of 3188 feet above mean sea level).

a) These General Specifications indicate the requirements and precautions to be taken during the execution of Electrical Installation works to ensure efficient, safe, economical and practical use of materials and equipment including prevention of risks and fire hazards.

b) This Section also covers the general requirements applicable to this works contracts for Electrical Installation works.

5.3. RELATED DOCUMENTS

These General Specifications shall be read in conjunction with the standard conditions of contract contained in other parts of the document and their correction slips, the specifications, Indicative Items, drawings and other documents.

5.4. DRAWINGS

The Shop drawings shall be submitted by the Contractor and got approved from the Engineer-In-Charge. Architectural drawings shall take precedence over other services drawings as to all dimensions. Any deviations in drawings will be brought to Engineer-In-Charge Notice before work is executed as directed by Engineer-In-Charge. Contractor shall verify all dimensions at site and bring to the notice of the Engineer- In Charge any or all discrepancy or deviations noticed.

5.5. APPROVALS

a) The Contractor shall obtain all information relating to local regulations, Bye-Laws, sanction and release of electrical connection, application of any and all laws relating to his work or profession and need to execute the work as required. All statutory certificates shall be provided by the Contractor.

b) Contractor shall obtain sanction of electrical load, approval of the complete installation including D.G. Set and release/ enhance of electrical connection from the relevant inspection/ sanctioning Authorities at all stages and on completion of the installation work. The Contractor shall pass on these approvals to the Engineer-In-Charge.

c) All the materials sample to be approved before procurement / execution by consultant/PMC/Engineer-In-Charge.

5.6. CODE REQUIREMENTS

All work shall be done in accordance with the IS Code amended up to date/ Indian Electricity Rules.

5.7. CODES & STANDARDS

The manufacturing and the installation shall be in accordance with established codes, sound engineering, practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector & CEIG, pollution control boards, SEB as applicable before commissioning of electrical / DGs, Indian Electricity Act, Indian Electricity Rules, Factory Act, Pollution Control Act. latest amended.

IS-732	Code of practice for electrical wiring installation system voltage not exceeding 650V.
IS-3043	Earthing.
IS-7689	Guide for control of undesirable static electricity.
IS-3716	Insulation co-ordination application guide.
IS-8130	Conductors for insulated electrical cables and flexible cords.
IS-5831	PVC insulation and sheath of electric cables.
IS-3975	Mild steel wire, strips & tapes for armour cable.
IS-3961	Current rating of cables.
IS-694	PVC insulated (heavy duty) electric cables for working Voltage up to including 1100 volts.
IS-424-1475 (F-3)	Power cable flexibility test.
IEC-439/IS-7098	Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.
IS-1554	PVC insulated cables up to 1100 volts.
IS-10810	Test procedures for cables.
IS-6121	Cable glands.
IS-10418	Cable drums.
IEC-754(1)	FRLS PVC insulated cable.
ASTM-D-2863	Standard method for measuring minimum oxygen concentration to support candle like combustion of plastic (oxygen index).
ASTM-D-2843	Standard test method for measuring the density of smoke from burning or decomposition.
IS/IEC-62305	Code of practice for the protection of buildings and allied structure against Lightning.
IEEE-383	Standard for type test class-IE, electric cables, field splicers and connections for power generation station.
IS-13947/IEC 947	Air circuit breaker/moulded case circuit breaker.
IS-8623	Specification for factory built assemblies of switch gear and control gear for voltage upto and including 1000vac/1200vdc.
IS 1018	Switch gear and control gear selection/installation and maintenance.
IS-1248	Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS-13779	Digital measuring instruments and testing accessories.
IS-3156	Voltage transformer.
IS-2705	Current transformer for metering and protection with classification burden and insulation.
IS-2147	Degree of protection provided by enclosures for low voltage. Part I,II,III Switch gear and control gear
IS-3427	Metal enclosed switch gear and control gear
BS-162	Safety clearance.
IS-3202	Code of practice for climate proofing of electrical equipment.

IS-375	Marking and arrangement for switch gear, bus bars, main connections and auxiliary wiring.
IS-722	Ac electric meters.
IS-3231	Electrical relays for power system protection.
IEC-255	Electrical Relays.
IS-5082	Electrolytic copper/aluminium bus bars
IS-2834	Capacitors.
IS-2713	Steel tubular pole.
IS-335	Specification for insulating oil.
IS-3837	Specifications for accessories for rigid steel conduit for electrical wiring.
IS-1180 & 335	Distribution transformer
(PART I,II,III) GI/STEEL/PVC conduit pipe for electrical wiring.	
IS-2274	Code of practice for electrical wiring installation system voltage not exceeding 650V.
IS-6665	Code of practice for industrial lighting
IS-3646	Interior insulation part 1&2
	a) Supply Voltage 11 KV as applicable
	b) Neutral Earthing, Solid Earthing
	c) Voltage Regulation + 10%
	d) Frequency Regulations + 3%
IS-1944	Code of practice for lighting of public through fares.
IS-7752	Guide for improvement of power factor consumers installation.
IS-13346	General requirement for electrical for explosive gas atmosphere.
IS-13408	Code of practice for the selection, installation and maintenanceof electrical apparatus for use in potentially explosive atmosphere.
IS-12360	Voltage and frequency for ac transmission & distribution system.
IS-5572	Classification of hazardous area for electrical installations.
IS-5571	Guide for selection of electrical equipment for hazardous area.
IS-4201	Application guide for Current Transformer.
IS-4146	Application guide for Voltage Transformer.
IS-10028	Code of practice for installation and maintenance of transformer.
IS-8478	Application guide for on load tap changer.
IS-10561	Application guide for power transformer.
IS-1646	Code of practice for fire safety of buildings electrical installation.
IS-3034	Code of practice for fire safety of industrial building-electrical generating and distribution station.
IP-30	National electrical code (NEC) BIS publication.
IS-4722	Rotating electrical machines.
IS-4889	Method of determination of efficiency of rotating electrical machines.
IS-325	Three phase induction motors.
IS-4729	Measurement and evaluation of vibration of rotating electrical machines.
IS-900	Installation and maintenance of induction motors.

IS-4029	Air break switches.
IS-2208-9224	HRC cartridge fuses.
IS-2959	Contractors.
IS-9537	Rigid steel conduit.
IS-1030-1982	Specification for carbon steel castings for general engineering purpose.
IS-1601/ BS-649	Performance& testing of Internal Combustion (IC) engines for general purpose.
AIEE-606(1959)	Recommended specification for speed governing of I.C. engine generator units.
BS-5514/IS-3046 8528(Part-2)	Reciprocating IC engine driven A.C. generators.

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above. In case of any deviation /conflict of this specification with the codes & standards, the following order of precedence shall govern. Specification, particular specification if any and drawings. Indian regulations/codes and standards.

- Two separate Load Break Switches.
- A mechanism to operate and mechanically interlock the switches.
- An actuator made of a motorized unit or a double solenoid mechanism (both momentarily energized).
- A 3 phases monitoring device and control module (MDCM) for monitoring supply circuits and for transferring the load circuit from one supply to another.

The ATSE shall be fully integrated in one device. No additional wiring other than the power connection shall be allowed to facilitate the proper functioning of the ATSE with the MDCM. All the elements of the transfer switch equipment and control module shall be of the same manufacturer.

5.8.EXTERNAL ELECTRIFICATION

5.8.1. 11KV SUBSTATION WORK

11KV H.T. Metering Panel(Outdoor Type)

The Outdoor type floor mounted, dust, damp and vermin proof, cubicle HT. Metering Panel made out of 14 gauge CRCA sheet steel complete with conforming to relevant IS Standards and complete as required. H.T. Metering cubicle along with meter (Trivector meter shall Electricity Supply Authority) be got tested and approved from local electricity supply authority. The GA drawing shall be got approved by ELECTRICITY SUPPLY AUTHORITY before fabrication. The primary function of a metering panel in an HT panel is to measure various electrical parameters such as voltage, current, power factor, active power (kW), reactive power (kVAR), and apparent power (kVA). These measurements are essential for billing purposes, load management, and monitoring the health of the electrical system.

This specification covers the technical requirements of design, test at manufacturer's works, Supply, Testing and Commissioning of Electrical Work complete with transit insurance, transport, unloading at site, assistance for testing, commissioning and erection & all accessories for efficient and trouble-free operation. The manufacturer must have carried out installation based in Assam state with proven performance under Assam climatic condition (an altitude of 3188 feet above mean sea level).

11KV VCB Panel (Indoor Type)

General

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB's shall be suitable for operation on 11KV, 3 phase, 50Hz, AC supply.

Codes and Standards

The 11KV VCB Panel shall comply with the following standards as amended up to date.

IS: 2516 (Part I – Set 3): Indian Electricity Supply & regulations

IEC 60298 & IEC 60694

IS: 3427 & IS 12729: Vacuum Circuit Breakers

IEC: 298 (1987) (Annex. AA): Testing for Internal Arc

IEC: 529: Degree of Protection – IP 55

IS: 2544: Bus Bar Supports

IS: 2705 / IEC – 185: Current Transformer

IS: 3516 / IEC – 186: Potential Transformer

Rating

The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 350 MVA at 11KV. The rated making capacity shall be as per the relevant standards.

Accessories

Circuit Breakers shall be provided with the following accessories.

i. Auxiliary Switch with minimum 6 NO+ 6 NC auxiliary contacts.

ii. Shunt Trip & Closing coil

iii. Mechanical Operation Counter

iv. Spring Charging motor and handle for manual charging.

Submittals

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams for control and supervision of circuit breakers.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) Type test certificates along with oscillograms for breakers of identical design.

e) All GAD / Shop drawings and data shall be in English.

Type and Construction

The metal clad panel shall be made out of 2.0 mm thick CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer's standard shade**.** The Switch Board Shall be fully extensible with following compartment.

a. Circuit Breaker Compartment

b. Bus bar Compartment

c. CT and Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be mounted on the top / bottom of the panel at the front. The VCB shall consist of three air insulated poles incorporating mechanism of interrupters and suitable clearance between phases. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalized aluminum oxide. The contacts shall be of chromium copper and butt shaped. Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. The draw out carriage shall have two position for the circuit breaker viz isolated/test & service position.

Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy mono block designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

It shall be horizontal draw out & isolation type, fully interlocked, with dust and vermin proof construction, suitable for indoor installation**.** The panel shall be supplied with the manufacturer's test certificates**.** Certificates with date of manufacture and shall be complete in all respects as per details given in the bill of quantities. The switchgear constructions shall

be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

Total height of the H.T. Panel board shall be 2750mm approximately and width 1000mm (approx.). On the incoming breaker panel, a 100VA burden and Class I accuracy potential transformer 11KV/√3 /110V/√3 with LT fuses shall be provided. These shall be three single phase PTs cast resin insulated type. Adequate space at the rear of the panel shall be provided for termination of power & control cables. The panel shall be provided with suitable terminating arrangement for termination of cables. The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the bus bars & cable compartment for the fixed contacts. Safety shutters shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of bus bars side and cable side individually.

Mechanically operated circuit breaker auxiliary switches of minimum 6 NO + 6 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by using 1.5 sq. mm, 1.1KV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

L.T. Terminal blocks for control wiring shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 2.0KV for one minute. Bus bar compartment shall be provided at the rear. Electrolytic copper bus bars shall be of rectangular cross section and insulated. Bus bars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Bus bars shall be provided with necessary colour coding for phases indication. The bus bars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 50 deg.C. The standard clearance between phase bus bars to be maintained.

Bus Bar and Insulators

The bus bars shall made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-9IE of IS-5082 and air insulated. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Bus bar cross section shall be uniform throughout the length of switch board. Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high

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

Earthing and Protective Earthing

Copper earthing bus shall be provided. It shall be bolted/ welded to the frame work of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting with earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of bus bars & feeder circuit-IS 3043

Metering and Protection

The VCB Panel Board shall be provided with cast resin current transformers for metering and protection. The CT's shall conform in all respects to IS 2705-1992 Part-I, II and III. These shall have accuracy class of 1.0 for metering of 5P10 for protection. Potential transformers shall be epoxy cast resin type & conform to specifications of IS: 3156-1965 Part-I, II & III and shall be class-1**.** Electronic digital type Ammeter and voltmeter to be installed on panel**.** Electronic type digital energy analyzer having parameter of KW, KWH power factor, frequency etc. with 30 days memory shall be provided**.** All meters shall be tested for 2000V for 1 minute and shall be 96mm square pattern, flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W)**.** The electronic digital types IDMT relay (2 O/C + 1 E/F) to be provided as per B.O.Q. description.

Interlocking, Safety and Operating Mechanism

Vacuum Circuit Breaker shall have electrically operated mechanism for spring charging. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is 'On'. The circuit breaker cannot be switched 'ON' when the carriage is in any position between test & service position. The front door of the panel cannot be opened when the breaker is in service position or in an intermediate position. The low voltage plug & socket cannot be disconnected in any position except test/isolated position. The door cannot be closed unless the LV plug has been fitted. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed. Individual explosion vents shall be provided for breaker, bus bar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel. Circuit Breaker & sheet metal

enclosure shall be fully earthed. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

Additional Accessories

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

a. Maintenance Manual.

b. Racking in/out handle.

c. Foundation bolts.

d. One number Earthing Trolley for cable side.

Control Supply

The tripping circuit shall be at 24 Volt D.C. through a power pack unit.

Installation

11 KV switch board shall be installed and levelled on the foundation as per manufacturer's drawing. Bus bar connections shall be checked after installation. Cable end boxes shall be sealed after the cable work is completed to prevent absorption of moisture.

Tests

Factory tests

The circuit breakers panel shall be subjected to routine tests at manufacturers works in accordance with the details specified in the relevant IS specifications.

The vendor shall submit the type test certificate for following along with the offer.

a. Temperature rise test.

b. Impulse & power frequency voltage test.

c. Short time current test on circuit breaker.

Site test

1. Verification for completion of equipment, physical damage/ deformities.
2. Alignment of panel, interconnection of bus bars & tightness of bolts & connection etc.
3. Interconnection of panel earth bus bar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.

6. Control wiring verification after interconnecting of panel.
7. Check for free movement of circuit breaker, lubrication of moving part & other Parts as per manufacturers manual.
8. Manual/Electrical operations of the breaker and Functional test as per drawings.
9. Meggar before the Hi Pot test.
10. Meggar after the Hi Pot test.
11. CT/PT ratio/polarity primary injection test.
12. Secondary injection test on relays to practical characteristics.

These tests as per the clauses above will be witnessed by the Engineer-In-Charge/PMC/consultant at the works for which necessary information has to be given in advance to the Engineer-In-Charge/PMC/ consultant**.**

Technical Particulars of Switchgear Equipment (11KV)

Sl No	DETAILS	District Hospital & Emergency Center (Silchar & Udalguri)
1	Type	Indoor, cubicle type Indoor
2	System rated voltage	11KV
3	System maximum voltage	12KV
4	Frequency	50 Hz
5	Insulation Level	
A	1.2/50 microseconds Impulse withstand voltage	75 KV peak
B	One minute power frequency withstand voltage	28 KV rms
6	Rated Current	
A	Continuous	
	Bus bar	800 Amp
	Incoming Vacuum circuit breaker	800 Amp
	Outgoing Vacuum circuit breaker	800 Amp
B	Short time current for 1 seconds	18.3 KArms
7	Vacuum Circuit Breaker	Panel board VCB
A	Quantity	

Sl No	DETAILS	District Hospital & Emergency Center (Silchar & Udalguri)
	Incoming feeder	01 Nos.
	Outgoing feeder	02 Nos.
	Bus coupler	No
B	Rated breaking capacity	350 MVA
C	Total breaking time	3 Cycles (maximum)
D	Auxiliary voltage Control circuit	24 V DC
	Space heater and illumination lamp, etc.	230 V, 1 Ph, 50 Hz.
8	Potential Transformers	(At Incoming)
a	Quantity	1 each incoming panel
b	Voltage Ratio	11 KV / 110 V
c	Over voltage factor	As per IS – 3156
d	Accuracy class	0.5
e	Rated burden	100 VA
9	Current Transformer	
	Incoming	
	Core01	80/5, 15VA, Class 1.0 for Metering as per requirements
	Core02	80/5, 15VA, Class 5P10 for Protection
	Outgoings	
	Core01	40/5, 15VA, Class 1.0 for Metering
	Core02	40/5, 15VA, Class 5P20 for Protection
	Core03	40/5, Class PS for Transformer Differential Protection

Warranty/Guarantee

Products will be a period of 18 months from the date of Dispatch and commissioning as per Manufacture defects

11 KV/0.433 KV OIL TYPE DISTRIBUTION TRANSFORMER

General

The transformer shall be double wound core type with low loss, non ageing, high permeability, Prime Grade, CRGO with M4 grade or better, copper wound, perfectly insulated and clamped to minimized noise and vibrations. Major civil work such as foundations, trenches, etc will be paid as per civil works. Minor civil work like cutting and making good all damages caused during installation and restoring the same to their original finish will be inclusive in the price. Transformers will be as per CPWD specifications.

This specification covers the technical requirements of design, test at manufacturer's works, Supply, Testing and Commissioning of Electrical Work complete with transit insurance, transport, unloading at site, assistance for testing, commissioning and erection & all accessories for efficient and trouble-free operation. The manufacturer must have carried out installation based in Assam state with proven performance under Assam climatic condition (an altitude of 3188 feet above mean sea level).

OLTC Type

Transformer shall be outdoor duty type. The transformer shall be fabricated as per IS 1180 specification amended up to date. The Transformer loss will be as per 1180 Amended up to Date.

Specification Standard and Factory Test

Unless otherwise stated below, transformer & transformer oil shall conform to IS 1180 & 335 respectively.

TECHNICAL DETAILS AS PER IS: 1180 LEVEL 2

Sl.No	Description	(SILCHAR & UDALGURI) District Hospital
1	Rating (kva)	1250 kva (Outdoor Type)
2	Voltage Ratio (kv) (At No Load)	11/0.433 kv
3	Quantity	02 Nos.
	TECHNICAL PARTICULARS	Copper Wound, Class A Insulation
A	Vector Group	Dyn11
B	Tapping Range	+5% To -15% @ 1.25% steps
C	Tap – Changer	(OLTC) on HV winding (OLG Make) + RTCC Panel With AVR
D	Steps	16 Steps, 17 Positions
E	Temp. Rise (Oil/Wdg.)	40/45° C
F	Total losses at 50% Load (Max.)	3.3 kw

G	Total losses at 100% Load (Max.)	9.2 kw
H	Impedance at 75° C	5.1 % (+10% TO -10% IS TOL.)
I	Insulation Level	Class A
J	HV (KVp/KVrms)	75/28
K	LV (KVp/KVrms)	NA/3
L	Termination	
M	H.V./L.V./Orientation	Cable Box / Cable Box / 180
N	Fittings	Standard Fittings.
O	Paint	Polyrethane

Core

The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

Cooling

Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN).

Frequency

50Hz plus minus 3%

Rated voltage

Transformer shall operate at its rated KVA at any voltage plus minus 10% of rated voltage of that particular tap.

Vector group

Corresponding to the vector symbol Dyn-11

Connections

H.V side of transformer shall be provided with suitable size cable box for 3 core XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable. MV side of transformer shall be suitable for bus duct connection / XLPE Al. Ar. Cabling arrangement.

Tapping

ON load tap changing arrangement on HV side. The range for circuit taps, which shall be provided on H.V. side, shall be plus 5.1% & minus 5.1% in steps of 1.25%

Temperature Rise

The transformer shall conform to the requirements of temperature rise specified in IS: 1180. Continuously rated for full load, temp. rise not to exceed 50 degree C by thermometer in oil (55degree C by resistance)

Insulation Levels

The insulation levels shall be in accordance with IS 2076 (Part III) 1977 . Terminal Markings, Tapping & Connections.

The terminal marking, tapping 21 connections shall be in accordance with IS 2026 (Part IV) 1977. Requirements With Regards To Ability To Withstand Short Circuit.

As per IS 2026 (part I) 1977

Impedance Voltage

As per table 3 of IS 1180 / ECBC - 2017

On Load Tap Changing Switch

On load tap changer with RTCC panel and AVR PARALLEL OPERATION

Transformer shall be suitable for parallel operation with similar unit of same rates.

General Requirements Of Transformers

- Transformer shall be suitable for operating at rated capacity continuously at any of the taps under ambient conditions and with the voltage and frequency variations indicated without exceeding permissible temperature rise and without any detrimental effect to any part.
- Transformer shall be designed to be loaded as per IS:6600.
- All windings shall have uniform insulation resistance to earth.
- Disconnecting chamber shall be air filled. Suitable cable end box shall be provided for termination of cables. Gland plate for single core cables shall be non-magnetic.
- Transformer shall be able to withstand electrodynamics and thermal stresses due to terminal short circuit of the secondary, assuming the primary side is being fed from an infinite bus. All leads and windings in cores shall be properly supported. Short circuits withstand and duration shall be 1 secs. As per IS:1180.
- Short circuit test results for similar transformers shall be furnished.
- There shall be a marshalling box for gathering all alarm signals. All alarm shall be wired up to terminal strip provided in marshalling box. 20% spare terminals shall be provided. Armoured cable of 2.5 sqmm cu shall be provided along with suitable size glands for terminating these contacts in marshalling box.

- Guides shall be provided to facilitate tanking and untanking of the core with the coil assembly. The details of anchoring of core and coils assembly of tank shall be furnished.
- Radiators shall be provided on the tank to facilitate cooling. These shall be detachable type and shall be provided with isolating valves at ends, drain plugs and air release plug. Radiators of 1.2 mm thickness seamless steel tubing or pressed sheet steel.
- Means for lifting and jacking of transformer shall be provided.
- Class-A insulating material specified in IS:1271 shall be used. Paper insulation shall be new and free from punctures. Wood insulation, wherever used, shall be well seasoned and treated.
- The mineral oil shall comply with IS: 335. 10% extra oil in seal tins / drums shall be supplied. All valves shall be of globe type. Valve body of carbon steel and trim of 135 cr. Steel.
- Oil temp. Indicator for measuring top oil temp. shall comprise 150mm dial type thermometer pocket and capillary tube jacketed with PVC sleeve. Thermo-meter shall have 2 sets of contacts, one for alarm and the other for trip, and set points can be set by hand. Contacts shall be wired up to marshalling box.
- Buchholz relay shall be provided as per IS: 3637. It shall be double float type with two sets of contacts for alarm and trip with facility for testing by injection of air by hand pump and with cock for draining and venting of air. Relay shall be provided with shut off valves on conservator side as well as on tank side.
- Alarm and trip contacts shall be suitable for 1A 230 AC.
- A marshalling box shall be provided to accommodate all auxiliary devices except those which are to be located directly on transformer. It shall be of dust, weather and vermin proof type of sheet steel 2mm thick and shall have sufficient space for ease of cabling. 20% extra terminals shall be provided.
- All steel surfaces exposed shall be treated with suitable anti –trust, anti–corrosive paints.
- Bushing insulator shall be rated for max. System voltage and shall be as per IS. Bushing shall be enclosed in terminal box and shall be detachable from outside the tank. Separate neutral bushing shall be provided for earthing the neutral. When LT cable box is provided, a neutral bushing shall be brought out for solid earthing.
- Transformers shall have same percentage impedance & other characteristics with foundation plan parallel operation as per IS: 10028.

Fittings

The following accessories and fittings shall be provided with the transformer

LIFTING LUGS: The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.

ROLLERS: The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.

OIL CONSERVATOR: The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purposes of transport. It has to be provided with oil gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to provide. A connection pipe between the conservator and tank is to be provided, which projects inside the conservator.

AIR RELEASE VALVE: An air release valve shall be provided on top of the tank cover to facilitate of the entrapped air while filling of oil.

BREATHER: The transformer shall be provided with an indicating dehydrating silica gel breather of sufficient capacity.

DRAIN VALVE WITH PLUG: The transformer to be provided with drain valve with plug at the bottom of the tank.

DIAGRAM WITH RATING PLATE: One diagram and rating plate indicating the details of transformer connection diagram vector group tap changing diagram etc.

THERMOMETER: Dial type thermometer (150mm dia) with maximum set pointer 75 degree C electrical contacts for electrical contacts for electrical alarm at high temp.

EXPLOSION VENT: Explosion vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage in the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.

FILTER VALVE: Filter valve on the top of the tank.

BUCHOLTZ RELAY: Oil actuated relay equipment shall confirm to IS 3637-1966 (amended up to date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm /trip.

WINDING TEMPERATURE INDICATOR: Winding temperature indicator with electrical contact for alarm / trip.

OIL TEMPERATURE INDICETOR: Oil temperature Indicator with alarm & trip contacts.

MARSHALLING BOX: the transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay.

CONTROL CABLING: All control cables required from Marshalling box to H.T panel board for Trip / alarm of winding temp. Indicator, oil temp indicator, bucholhz relay etc. shall be provided and deemed to be included in the rate of transformer equipments.

TRANSFORMER OIL: First filling of oil.

EARTHING: Two separate earthing terminals are to be provided at the sides of the tank on both the sides for earthing.

SOAK PIT

Soak pit for oil filled transformer shall be made are per IS 10028 (Part II) 1981 with up to dated amendments. Sump shall be formed in the transformer room and shall be connected to soak pit outside the transformer room with a pipe. All the civil works required for the soak pit shall be done by the Contractor and the cost shall deemed to be included in quoted rates of the transformer item.

Instrumentation Manual

The Contractor shall submit three copies of manual of complete instructions for the installations, operations, maintenance and repair, circuit diagrams, foundations and trenching details shall be provided with the transformer.

Shop Drawings

The selected supplier shall prepare and furnish shop drawings for the approval by the consultant/PMC/client before commencing fabrications/ manufacture of the equipment. Shop drawing shall be based on the requirement laid down in the specifications. The manufacture of the equipment shall be commencing only after the shop drawings have been approved in writing by the consultant. Transformer shall be manufactured conforming to specification of Local supply authority.

Inspection

The transformer shall be inspected on arrival as per the inspection manual of the supplier

Shall be examined of any sign of damage and special attention shall be given to the following parts.

Oil tank and cooling tubes Bushes crakes or broken Oil sight glass

Installation

The transformer shall be installed as per transformer manual of the transformer supplier and conforming to Indian standards.

The transformer is to be erected on suitable size M.S channels embedded in the cement concrete flooring including providing & fixing the channel. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.

The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.

The transformer cable end boxes shall be sealed to prevent absorption of moisture.

The transformer natural earthing and body earthing shall confirm to Indian Standard.

Factory Test

The transformer shall be subjected to test as laid down in IS 2026 (Part I) 1977 at factory/manufacturing unit prior to dispatch of the transformer to the site.

All original test certificates shall be furnished. TESTING AT SITE

Prior to commissioning of the transformer the following tests shall be performed

Insulation resistance of the winding between phases and earth of Primary and Secondary side.

Winding resistance of all the winding on all tap positions shall be taken.

The supplier gives sufficient advance information about the test schedule to enable the PMC/Engineer-In-Charge to appoint his representative.

High Speed Resistor On Load Tap Changer General

High speed resistor on load tap changer shall be provided with the transformer wherever specified. The high speed resistor OLTC shall be for rated voltage up to 11KV rating current of 100 Amp, 3phase, 17 step conforming to Indian standard with AVR & RTCC panel.

Type And Construction

OLTC shall be a compact unit for use with three phase distribution transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprise of

- Tank
- Selector Switch
- Operation Mechanism
- Barrier Board
- Local control Gear
- Control cable Terminations
- AVR & RTCC panel

Tank

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, driving mechanism and Local control gear. Access to the compartments shall be made easy

by means of removable covers and a weather proof door. Anti- condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

Selector Switch

A selector switch transformer is designed to serve dual purposes. Firstly, it acts as a selector switch, allowing the user to choose between different input or output configurations. Secondly, it incorporates a transformer function, which means it can step up or step down voltage levels as needed.

Operation Mechanism

An impulse is received either from a remote control panel or from a local manual operation switch, which energies the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energized seals itself via its own contact and the driving motor commences to run. At a predetermined point a directional sequence switch closes, taking over the handling duties of the contactor whose original hold circuit shall be isolated. At the completion of the tap changer the directional sequence switch opens and de-energizes the driving motor. The arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

Barrier Board

Barrier board transformers serve similar purposes as other transformers, which is to step down voltage from a higher level to a lower level suitable for powering control circuits or devices. They are commonly used in industrial automation and control systems where space-saving and organized wiring are essential.

Local Control Gear

The primary purpose of a local control gear transformer is to step down voltage from a higher level (such as 208V, 240V, 480V, etc.) to a lower voltage suitable for powering control circuits and devices. Common output voltages for local control circuits can be 24V AC/DC, 120V AC, or 240V AC, depending on the specific application and requirements.

Control Cable Termination

A detachable undrilled gland plate and the terminal station for all the external connections shall be provided in the driving mechanism compartment of the tap changer.

Automatic Voltage Regulator

Solid state automatic voltage regulator shall be provided for the regulation of the secondary voltage of the power transformer with on load tap changer (OLTC). The band width control shall allows the dead band to be set in the terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limit around a particular nominal value with a specified sensitivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulations shall reset automatically after voltage correction. Solid state

lamps (LED) shall be provided to indicate voltage outside the preset limit & control relay operation.

RTCC Panel

RTCC panel shall be provided to operate OLTC from control room located in substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete. A.C supply ON/OFF lamp indicator & AVR relay operated operation indication. Cubical panel shall be totally enclose, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All the sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergone a regrious metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by the cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process, passivating in deoxidize to retain & augment the effects of phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving.

Warranty/Guarantee

The product covered by a period of 18 months from the date of Dispatch and commissioning, This guarantee is subject to be installation, commissioning & operation and maintenance of the transformer as per IS - 10028 and as per manufacture defects.

5.9.D.G. SET

Scope of Work

The specification shall cover complete supply, transportation, foundation, installation, testing and commissioning of diesel engine alternator set. All minor civil works including Foundation, electrical and other works associated with the testing, installation and commissioning of the sets shall be carried out by the Contractor as per specification.

1) Diesel engines directly coupled with alternators mounted on a rigid fabricated base frame with resilient anti-vibration mountings.
2) Alternator with excitation system and automatic voltage regulator (AVR) and necessary protection and metering CT's in terminal box of alternator.
3) DG Set mounted with Control Panel.
4) Acoustic Enclosure as per C.P.C.B. Norms.
5) Obtaining statutory approvals for DG set system.
6) Exhaust piping with Silencer, associated wiring and accessories.
7) Exhaust Gas Treatment System

Intent of Specification

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

Codes and Standards

The equipment furnish under this specification shall conform to the following latest standard, except where modified or supplemented by this specification:

BS:5514	Specification for reciprocating internal combustion engine.
BS:5000	Rotating electrical machines of particular type or for particular applications.
IS:1239 (Part - I&II)	Mild steel tubes and fittings.
IS:1651	Stationary cells and batteries lead acid type (with tubular positive plates).
IS:9224	Specification of low voltage fuses, General Purpose.
IS:4540	Mono-crystalline semi-conductor rectifier assemblies and equipment.
IS:5	Colours for ready mixed paints.
IS:4722	Rotating electrical machines
IS:1248	Specification for electrical indicating instruments.
IS:10000	Methods of tests for internal combustion engines.
IS:10002	Specifications for performance requirements for constant speed compression ignition (Diesel) engine for general purposes (above 20KW).
IS:2147	Degree of protection provided by enclosure for low voltage switchgear and control gear.
IS:1600	Code for type testing of constant speed IC engines for general purposes.
IS:1601	Performance of constant speed IC engines for general purposes.
ASME Power	Internal combustion engines. Test Code PTC-17.

Diesel Engine

Diesel Engine shall be stationary, compression, ignition, totally enclosed, water cooled, stroke cycle, cold battery starting, turbo charged and after cooled heat exchanger cooled 1500 RPM in accordance to BS:649/5514 and IS1000/3046 specification complete with all accessories.

Cooling System

Cooling system shall have radiator, Thermostat & engine built pumps, Corrosion Resistor, Self contained piping for secondary circuit, By pass thermostat.

Fuel System

Fuel System shall have PT Fuel Pump, Injectors, Fuel filters, Self contained piping & houses, Complete piping.

Lubricating System

Lubricating system shall have Oil pump, Strainer, Lube oil cooler, Oil filter, Bypass filter, Self contained piping, Lube oil priming pump if required.

Exhaust System

Exhaust system shall have Exhaust Manifold, Flexible piping, Residential silencer to limit the noise level and extending silencer outside the canopy.

Starting System

Starting system shall have Starter 24V with suitable ampere capacity, Charging Alternator with inbuilt regulator 24 V minimum 30 AMP DC or as per battery capacity, Connecting links between battery & alternator. The engine shall be suitable for black start.

Main and Big End Bearing

The mail and big end bearing shall be detachable shells of high grade bearing material, and shall be pre finished. The dimensions of big end bearings shall be such that the connecting rods can be withdrawn through the cylinder liners.

Coupling Arrangement

Coupling arrangement shall have Flexible coupling, Flywheel, Flywheel Housing, Coupling Guard

Instrument Panel

Instrument Panel shall have-

- Lube oil pressure gauge
- ATS System
- RMP Indicator & Hour Meter.
- Battery charger ammeter.

- Starting switch with key

Safety Control Trip

- Low Lube oil pressure
- High Water temperature
- Engine over speed.
- Lube oil temperature.

Alternator Specification

For Silchar & Udalguri District Hospital

Manufacturer	Stamford / Leroy Somer IS: 4722/BS 2613
Output	625 KVA self excited, self regulated foot mounted fitted with ball and roller bearings and having PMG, droop CT for paralleling. This shall give full output of 625 KVA at 40 deg. C.
Power factor	0.8
Rated Generating Voltage	415 Volts, 3 phase 4 wire systems
Voltage regulation	+/- 1.0% all load between no load to full load & power factor 0.8 to unity AVR shall be mounted in alternator.
Frequency	50 HZ
Speed	1500 RPM
Overload Capacity	10% for one hour in any 12 hours of operation without Exceeding temperature rise limits specified in BS:2613 when corrected to ambient temperature at site
Class of Insulation	H and temp. Rise limited to class H
Space Heater	To be provided if required.
Winding connection	Star connection (all six leads will be brought out of stator frame).
Termination	Termination box shall be amended to connect the bus duct.

The alternator shall be self-excited, self regulated, self ventilated in brush less for suitable automatic voltage regulator and shall conform to BS: 2613 or equivalent standard and shall give rated output at NTP conditions. The alternator shall have space heater which shall be connected with breaker NO / NC contacts and this should be able to cut off with thermostat.

5.10. OTHER ACCESSORIES

Fuel Tank

Day service fuel tank shall be made of 2mm thick MS sheet of 990 litres capacity for each set with all accessories such as oil level indicator, inlet pipe connection, outlet pipe connection, trough to collect split oil, air vent pipe with air filter, manhole with cover, low level and full level float valve arrangements with all fittings interconnections between tanks. The tank shall be provided with suitable calibration scale.

Base Frame

M.S. Fabricated adequately machined base frame complete with lifting, facilities pre-drilled foundation holes suitable for permanent installation on foundation shall also be supplied. The base frame shall be manufactured with steel and shall be stress relieved. Manufacturer shall specify what measures are taken to reduce the stresses.

Batteries

For electrical control ckt of 24V D.C. of suitable ampere hour complete with battery charger, leads and wooden base plate and shall be placed inside canopy.

Fuel system

The engine shall be capable of running on High Speed Diesel fuel oil. The fuel consumption of the engine at full, three quarters and half of its rated power output shall be indicated by the Contractor in the bid. A fuel service buffer tank, common for two DG set with 990 litres capacity shall be provided on a suitably fabricated steel platform. The tank shall be complete with level indicator marked in litres, filling inlet with removable screen, an outlet, a drain plug, an air vent and necessary piping. The fuel tank shall be painted with oil resistant paint. Service tank level switches (2 Nos. per tank) for alarm & trip shall also be provided by the bidder. All pipe joints should be brazed / welded. A hand pump for pumping the fuel into the fuel service tank together with necessary pipes or tubing shall be provided.

Silencer

Exhaust silencer shall be residential type to reduce the noise level.

Cooling

The diesel engine shall be radiator cooled type on heat exchanger cooled if installed.

Engine Governor

The governor shall be Electronic type suitable for class A-1. This shall control the generator frequency, and shall be suitable for operation as per the selected battery voltage (24 V DC.). The governor shall be provided with a manually adjustable over speed trip mechanism to automatically shut-off the engine or the fuel supply if the set reached 120 % of rated speed. Governor shall be capable to maintain zero speed rate or regulation and shall be Al type as per BS:5514 in order to take care of heavy motor starting. It shall have necessary

characteristics to maintain the speed substantially constant even with sudden variation in load. However, a tripping shall be provided if speed exceeds maximum permissible limit.

Turbo Charger

It shall be of a robust construction, suitable of being driven by engine exhaust having a common shaft for the turbine and blower. It shall draw air from filter of adequate capacity to suit the requirements of the engine.

Starter Battery

The battery shall conform to the requirement of IS: 1651. Starting battery sets of 24 V, heavy duty high performance approved make/quality shall be provided to enable crank & start the engine even in cold/winter morning conditions. Type/voltage/AH capacity of same on 20 hour rated discharge period shall be indicated in the offer. The battery shall be capable of performing at least (6) six normal starts without recharging.

The battery shall be provided with 2 Nos. cables, minimum 1.5m long heavy duty PVC insulated cabling with brazed tinned lug at one end and with brazed tinned brass terminal lug at battery end - for connecting batteries to cranking system - with 0.25 m long inter battery connecting cable.

The lugs shall be clearly stamped (+) or (-) and positive cable also red sleeved for easy identification.

Engine Safeguard

- Safeguards shall be provided and arranged when necessary to stop the engine automatically by the following:
- Energizing a solenoid coupled to the stop lever on the fuel injection pump rack.
- De-energising the “fuel on” solenoid.
- Energizing the “fuel - cut off” solenoid.
- If any of the door opens.
- The operation of the safeguard shall at the same time give individual warning of the failure by illuminating an appropriate local visual indicator and remote alarm at generator panel.
- The contactors, relays and other devices necessary for signal and control, for above purposes shall be provided at Generator panel.
- At the set at a easily accessible place an “EMERGENCY STOP” mushroom head stay put type P.B shall provided to stop the set in emergency mode.
- The safe guard to “STOP THE SET” shall stop the set irrespective of mode selection of the set viz Auto, Manual or test for following cases, with simultaneous isolation of alternator ckt.

- Emergency stop P.B's operation.
- Over speed.
- Low lube oil pressure.
- Sound Attenuating Acoustic Enclosure.
- Sound Attenuating Acoustic Enclosure should have pleasant and aesthetical looks and should be able to bring down the noise to 75 decibels when measured at a distance of 1 meter away from the set.
- The DG set should be supported on a base frame in an MS Sheet enclosure with suitable ducting for air inlet and outlet. The door and enclosure should be given corrosion resistant treatment and painted to be weatherproof and long lasting. Resin bonded Glass / Mineral / Rock wool of high density with perforated MS Sheet should be provided and covered with tissue paper. Enclosures should be provided with durable locking system with doors duly gasketed with neoprene rubber.
- Exhaust gases should be taken out from the DG Set by means of MS Pipe and a noise suppressor.
- Proper care should be taken for engine heat rejection in order to have safe working temperature inside the enclosure by provision of fans etc, as required. The design aspect should ensure free and uninterrupted flow of suction and exhaust air in order that the temperature rise of the enclosure with respect to the ambient is less than 7°C.
- Radiator hot air shall be throughout on top instead of front. The arrangement shall be made accordingly in acoustic enclosure.

DEF Tank

- lDEF/Aqueous urea to sets off the chemical reaction with Exhaust gas
- Tank size is optimized in accordance to DEF consumption
- Supply Module & DCU (DCU - Dosing control unit)
- Control & monitor the DEF(DEF - Diesel exhaust fluid)
- Exhaust Gas Treatment System
- DOC & SCR system sets off the reaction to meet the latest CPCB norms
- (DOC - Diesel oxidation catalyst & SCR - Selective catalytic reduction)
- Reduction in NOx & HC
- Reduction in PM

Erection, Testing & Commissioning

The entire work of erection, testing and commissioning of equipment supplied under this package shall be carried out by Contractor and performance and guarantee tests to be conducted at site are also included under the scope of this specification. For this purpose the Contractor shall depute suitable qualified technical supervisor to site on advance intimation to the Engineer-In-Charge along with all special testing equipment required for testing and performance and guarantee tests. The supervisor(s) shall be responsible for the installation, testing, commissioning checks and performance & guarantee tests mentioned in relevant clauses of this volume and the checks recommend by the Contractor.

The Contractor shall submit sufficiently in advance the bio-data of the supervisor giving details of his experience for Engineer-In-charge's approval.

The Contractor shall ensure that the equipment supplied by him are installed in a neat workman like manner such that they are leveled, properly aligned and well oriented. The tolerances shall be established in Contractors drawings and/or as stipulated by the Engineer-In-charge .

All special tools and tackles and spares required for erection, testing and commissioning of equipment shall be supplied by the Contractor. The bid shall include a list of these special tools, tackles and spares along with their item wise prices. The total cost for these tools, tackles and spares shall be included in the bid price.

Erection, testing and commissioning manuals and procedures shall be supplied, prior to dispatch of the equipment.

The Contractor shall ensure that the drawings, instruction and recommendations are correctly followed while handling, setting, testing and commissioning the equipment.

Commissioning Check Tests / Performance and Guarantee Test

- In addition to the checks and test recommended by the manufacturer, the Contractor shall supervise the following acceptance tests to be carried out on each test.
- Load test
- The engine shall be given test run for a period of at least 2hours depending upon the actual power factor of the load and set shall be subjected to the maximum achievable load without exceeding the engine or alternator capacity.
- This full load test is to be followed immediately by a 10% overload run for one hour. The performance of the engine, alternator and exciter shall be satisfactory at the end of this overload run.
- At the end of the full-load run, and again at the end of the over-load run, tests for temperature rise and insulation resistance of the alternator as specified shall be taken.
- Full load test can be performed at site or at manufacturer's works before dispatch and shall be monitored by the Client/Consultants/Representative.

- Regulation Test
- The automatic and manual regulation of the alternator load at half and full rated load shall be tested for a nominal volts of 240 Volts, between phase to neutral and at 0.8 p. f. to verify the requirements of voltage and frequency variation as per IS:4722.
- Speed and Governing
- The speed of the engine shall be verified to ensure that it conforms to the requirement of BS: 5514.

Warranty/Guarantee

The DG Set is covered by Warranty/Guarantee for 2 years from the dispatch and commissioning and as per manufacture defects.

5.11. PARTICULAR REQUIREMENTS

SL NO.	DESCRIPITION	TYPE/SCOPE
1	Service	Indoor
2	Type standing	Cubicle, Metal enclosed free
3	Degree of Protection	IP 52
4	Rated Voltage	433V
5	Bus bars	
a	Number phase / wires	3 Phase, 4 wire.
b	Continuous current	As per particular requirement
c	Frequency	50 HZ
d	Fault level	35 KA
e	Material	Aluminium
6	Insulation level	
a	Power frequency withstand voltage dry	2.5 KV RMS
7	Bus bar support insulator	
a	Material	FRP /DMC /SMC
8	Design Ambient Temperature	50 Deg.C
9	Painting	Epoxy Powder coating.
10	Earthing	
a	Material	Aluminium
b	Size	As required
11	Reference Standard	IS 13947

5.12. EXHAUST PIPING (D.G. FLUE GAS EXHAUST SYSTEM):

Scope of Work

The scope of this section comprises supply, installation, testing & commissioning of D.G. Flue Gas Exhaust System pipes & pipe fittings etc. As detailed below in specifications. All pipes and fittings etc. Shall conform to relevant Indian standards.

D.G. Flue Gas Exhaust Piping

D.G. Exhaust pipes shall be M.S. Black pipes (B Class / 5.0 mm thick) up to 150 mm and MS ERW Black Pipes above 150 mm and it shall conform to IS:1239 (Part 1) -1991 & IS:3589 – 1991 Grade 330 with latest amendments.

All piping and their steel supports shall be thoroughly cleaned and primer coated before installation.

Pipe Insulation (D.G. Flue Gas Exhaust Piping System)

The scope of this section comprises supply, installation, testing & commissioning of D.G. Flue Gas Exhaust Pipe Insulation and Aluminium Cladding. All insulation material and aluminium cladding shall conform to relevant Indian standards.

Safety Materials

Description of Work

A. Insulation Mats

B. First Aid charts and First Aid Box

C. Danger Plate

D. Fire Extinguishers

E. Fire Buckets

F. Tool Box

G. Caution Board

H. Key Board

Applicable Codes & Standards

A. IS : 15652 Insulation mats

B. IS : 2878 Portable C02 Fire Extinguisher

C. IS : 2546 : Fire Buckets

D. ANSI/NFPA 70 - National Electrical Code.

Specification

Shock Treatment Chart with 8 mm thickness Photo laminaon -Size 18" X 24"

First Aid Chart and First Aid Box

A. Charts (one in English, one in Hindi, one in Regional Language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominantly provided at appropriate places. Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in sub-station.

B. Acrylic door with Medicines - Medium - Size : 11" x 12" x 6"

Danger Plate

A. Danger plates shall be provided on HV and LV equipments. LV danger notice plate shall be 200 mm x 200 mm made of mild steel atleast 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

B. Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick.

Fire Extinguishers

A. Portable CO_2 conforming to IS: 2878-1976 dry chemical (conforming to IS 2171-1976) extinguishers shall be installed in the sub-station at suitable places (like HT/LT panel rooms) as specified.

B. Foam type fire extinguisher shall be installed in Transformer Room.

Fire Buckets

A. Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

Tool Box

A. A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

Caution Board

A. Necessary number of caution boards such as "Man on Line" "Don't switch on" etc. shall be available in the sub-station.

B. The caution Board shall be of size 300 mm x 200mm made of mild steel, 2mm thick, vitreous enameled white on both sides and with inscriptions in original red colour on front side as required.

Key Board

A. A key board of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas.

B. The key board shall be made of 12mm thick first class teak wood shall be of size 400 mm x 300m and with adequate depth to hold the keys. It shall be provided with a lockable type

hinged glass door made of 12 mm. Thick first class teakwood frame with 3 mm thick sheet glass fixed with piano hinges. The key board shall enough number of hooks for hanging the castle keys and all other keys of the sub-station and allied areas. It shall be painted with one coat of wood primer and two coats of white enamel paint.

Insulation Mats

A. Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

B. Insulating Mat Class-B. 2.5mm Thickness x 1mtr width, Working Voltage: Up TO 11kv, AC Proof Voltage : 22KV ,Dielectric Strength: 45 KV as per IS:15652-2006 ISI marked, Color: Black

5.13. MAIN LT PANEL (AS PER IEC 60439 PTTA PANEL)

General

This System covers the detail requirements for GAD/Shop Drawing Manufacturing, Testing at works. Main L.T. Panel shall be made out of CRCA sheet steel indoor type, floor mounted, free standing, totally enclosed, extensible type, air insulated type for use on 415 Volts, 3 phase with neutral, 50 cycles/sec system. The both incomers (Transformer and DG) have mechanical and electrical interlocking with Automatically changeover the power to the system.

IEC 60439 and IEC 61439 are standards for low-voltage switchgear and control gear assemblies, including main low-tension (LT) panels. Both standards specify the requirements for these assemblies, but they have different approaches and updates reflecting advancements in technology and changes in industry practices.

The equipment shall be designed to conform to the requirements of:

i. IS: 8623- Factory Built Assemblies of switchgear and control gear.

ii IS: 4237- General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

iii. IS: 2147- Degree of protection.

iv. IS: 375- Marking and arrangement of bus bar.

Individual equipment housed in the Main L.T. Panels shall conform to the following IS Specification.

i. Air circuit breakers/Moulded case circuit breaker IS: 60947 (Part-II) & IEC 60947(2)

ii. Fuse switch and switch fuse units - IS: 13947 (Part-3) & IEC 947 (3).

iii. HRC fuse links - IS: 13703

iv. Current Transformers - IS: 2705

v. Voltage Transformers - IS: 3156

vi. Indicating Instruments - IS: 1248

vii. Integrating Instruments - IS : 722

viii. Control Switches & Push Buttons - IS : 6875

ix. Auxiliary Contactors - IS: 13947 (Part-4/Sec.-I) & IEC 947 (4/1) Relays - IS: 3231

Submittals, Shop Drawing and Technical Data

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams for control and supervision of circuit breakers.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) Type test certificates.

Construction

1. Made out of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
2. The degree of protection being not less than IP 42 to IS: 2147.
3. Suitable for extensible on both sides by the addition of vertical sections after removal of the end covers.
4. Shall be suitable for cable entry from top / bottom both except wherever indicated through removable cable gland plate of 3mm thick. Compression gland shall be staggered in alleys so as to maintain necessary clearance between cables.
5. Fire retardant polycarbonate sheet shall be provided for viewing panels housing MCB's at eye level. Cable channels are to be used wherever possible for aesthetic look.

   Lifting hooks / angles shall be provided on the panel. Panel shall have 20% free space for future use.

   Panel shall be provided with louvers having wire mesh inside for ventilation. Each vertical section shall comprise of:

   i. A minimum 2mm thickness front framed structure of rolled/folded sheet steel channel section rigidly bolted together. This structure shall

house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 100mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. Cable chamber housing (In rear of panel) the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. Front and rear doors fitted with dust including neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust. All door shall be lockable mounted lock.

The height of the panels should not be more than 2400 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be more than 1500mm. Operating handle shall not be higher than 1800mm.The minimum height for operating handle shall be 300 mm from floor level.

Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded.

The apparatus and circuits in the power control centers shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main L.T. Panel shall have the following minimum clearances.

i. Between phases - 26mm

ii. Between phases and neutral - 19mm

iii. Between phases and earth - 19mm

iv. Between neutral and earth - 19mm

For any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions. Creepage distances shall comply to those specified in relevant standards. All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

Metal Treatment and Finish

All steel work used in the construction of the L.T. cubicle panels should have undergone a rigorous metal treatment process as follows:

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.

vi. Powder Coating paint of colour approved by Architect/Consultant/ Engineer-in-charge.

Bus Bar

The bus bars shall made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-9IE of IS-5082 and air insulated. The bus bars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of required rating of fault level as per actual calculation 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 bus bars. Large clearances and creepage distances shall be provided on the bus bar system to minimize possibilities of fault.

The Panel shall be designed that the cables are not directly terminated on the terminals of breaker/switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium bus bars shall be considered as 0.8 Amp/sq.mm of cross section area of the bus bar. The main bus bars shall have continuous current rating throughout the length of L.T. Panel. The bus bar system shall consists of main horizontal bus bar and auxiliary vertical bus bars run in bus bar alley/chamber on either side in which the circuit could be arranged/connected with front access. The minimum size of vertical bus bar shall be as per fault level of panel i.e 50 KA.

In case of copper bus bars, high conductivity electrolytic grade copper with current density not less than 1.4 Amp/ sq. mm shall be used. Bus Bar shall be tinned.

Connections from the main bus bars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars to be colour coded with PVC sleeves.

Cadmium plated G.I. nuts and bolts shall be used for making bus bar to bus bar connections in aluminium bus bars.

Whenever copper bus bar and aluminium bus bar are connected to each other, bimetallic strip shall be used. In case of copper bus bar, tinning shall be done.

Bus bar calculation shall be submitted along with manufacturing drawing of panel for approval with bus bar manufacturer data sheet.

Medium Voltage Air Circuit Breaker

Type And Construction

The ACB shall confirm to the requirements of IS 13947-2 and shall be type tested & certified for compliance to standards from–CPRI. The circuit breaker shall be suitable for 415 V + 10%, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing / sheet metal housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" “TRIP” indications.

The ACB shall be 3/ 4 pole with modular construction, draw out, manually or electrically operated version as specified. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity (Icu) and short circuit withstand values (Icw) for 1 sec.

Icu = Ics = Icw = shall be based on actual calculation.

Circuit breakers shall be designed to ‘close' and `trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Inspection of main contacts should be possible without using any

tools. The ACB shall be provided with a door interlock. i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open.

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 ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open. It should be possible to change settings on load.

Minimum 4 NO and 4 NC auxiliary contacts shall be provided on each breaker. Break time of ACB shall not be more than 70 milli second in case of short circuit.

Rated insulation voltage shall be 1000 volts AC.

Cradle

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position of the circuit breaker on the cradle.

Racking Interlock in Connected/Test/Disconnected Position.

Service Position : Main Isolating contacts and control contacts of the breaker are engaged.

Test Position : Main Isolating contacts are isolated but control contacts are still engaged.

Isolated Position : Both main isolating and control contacts are isolated.

There shall be provision for locking the breaker in any or all of the first three positions mechanically.

The following safety features shall be incorporated:

a. Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition.

b. Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position.

c. All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn.

d. All Switchgear module front covers shall have provision for locking.

e. Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.

Protection

All breaker (ACB's) should be equipped with static release to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following four zones:

- Time protection.
- Short time protection with intentional delay.
- Instantaneous protection.
- Ground fault protection.

1 P&C Unit shall be microprocessor based RMS current sensing type.

2 P&C Unit shall have in-built overload, short-circuit, instantaneous, earth-fault & neutral overload protection and Release shall annunciate each fault in its chassis through LED. Protection release shall be provided with Test button to check healthiness of micro-processor.

3 Protection release should have inbuilt current metering for phase, ground & neutral current.

4 Transformer & DG set Incomer ACB releases shall have LED Display showing all Power & Energy Parameters (I, Imax, %loading, Iavg, V, Freq, PF, W, VAr, VA, Wh, VArh, Vah, MD-Active, MD-Reactive, MD-Apparent, Temperature in each Phase-Deg C). They shall also give additional protection against Under current, Current Unbalance, Under Voltage, Over Voltage, Under frequency, Over frequency, Lead/Lag PF, Maximum Demand, Phase Sequence etc & with RS485 communication port. All Outgoing ACB releases shall have LED Display for all Current Parameters.

5 All Main Incomer ACBs shall have inbuilt Temperature rise protection for protection against abnormal Temperature rise at terminals.

6 P&C Unit shall provide wide range of Overload protection curves (such as I2t, I4t, SI & LI/VI) offering precise co-ordination with large variety of electrical loads.

7 Release shall have option of Enabling/Disabling each protection function as per system requirement.

8 Release shall be password protected to prevent unauthorized access to protection settings.

9 All ACBs shall have 2 storable sets of LSIG protection settings to provide adequate protection against loads varying as per time & source changeover from Trfr to DG.

10 All ACBs shall have Double Short Circuit Selectivity and the same shall be with Adjustable Time Delay.

11 All ACBs shall provide at least last 5 trip data history & last 10 event history for analysis.

12 The release shall be equipped with In-built Thermal Memory & Cold pick-up with Adjustable Time Delay.

13 It shall be possible to interchange protection release and upgrade release for communication & Power metering. It shall also be equipped with smart-card module for easy parameterization of P&C Unit.

14 All ACBs shall provision of Zone Selective Interlocking (ZSI) feature for achieving Total selectivity.

Safety Features

a. The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.

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

c. There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Farthing bolts shall be provided on the cradle or body of fixed ACB.

d. The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.

e. It shall be possible to bolt the draw out frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

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

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

h. The ACB shall provide in built electrical and mechanical anti-pumping.

Testing

Testing of each circuit breaker shall be carried out at the works as per relevant IS Code of Practice and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

i. Impulse withstand test.

ii. Power frequency withstand test.

iii. Short circuit test.

iv. Temperature - rise test under rated conditions.

ACCESSORIES:

All ACBs equipped with Shunt Release shall have the operating voltage range from 10% Un to 110% Un to ensure intentional tripping even at high voltage drops during short circuit.

All ACBs shall have the provision of annunciating different types of faults & overloads at remote location.

There shall be provision to continuously monitor the healthiness of the shunt trip coil irrespective of the Breaker operation.

P&C Unit of Incomer ACBs shall have provision for future enhancement of their functionality (to provide more Advance & complete system protection) by adding supplementary modules on it.

All ACBs shall provision of Zone Selective Interlocking (ZSI) feature for achieving Total selectivity.

Equivalent ACB Models & Releases

S.No	Product	Lauritz Knudsen	Siemens	ABB	Schneider
1	ACB – Main Incomer (EB/DG)	Omega – MTX 3.5EC	3WA – ETU600 LSIG Hi-Z	E-Max 2 – PR123/P	MTZ – Micrologic 6X
2	ACB – Outgoings & Sub Incomers	Omega – MTX 1.5G	3WA – ETU600	E-Max 2 – PR122	MTZ
3	MCCB 200A & above	D-Sine MTX2.0 + Display	3VA-ETU560 (with display)	T Max – PR332/P (with display)	Compact NSX – 6 E (with display)
4	MCCB 160A & below	D-Sine	3VA	T Max	Compact NSX

5.14. MOULDED CASE CIRCUIT BREAKER

General

MCCBs should be current limiting type with trip time of less than 10 msec under short circuit conditions. The MCCBs should be either 3 or 4 poles fixed type. The MCCBs shall comply with the requirements of IEC 60947-2/ IS60947 – Part 2

MCCBs shall be suitable for 3 Phase 415 Volts AC 50 HZ supply. Rated insulation voltage (Ui) 690/750V AC and rated Impulse voltage 8 KV.

The moulded case circuit breaker shall have a rated service short circuit breaking capacity of not less than 36 KA RMS (Ics=100% Icu) at 415 volts AC or as specified in BOQ.

Moulded Case Circuit Breakers shall be incorporated in sub distribution boards wherever specified. MCCB's shall conform to IS 13947-2 and / or IEC 947-2 in all respects. MCCB's shall be suitable either for single phase AC 230 volts or three phase 415 volts.

Frame Sizes

The MCCB's shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i)	Up to 100A rating	…….	100Amp frame.
ii)	Above 100A to 200A	…….	200Amp frame.
iii)	Above 200A to 250A	…….	250Amp frame.
iv)	Above 250A to 400A	…….	400Amp frame.
v)	Above 400A to 630A	…….	630Amp frame.

Constructions

MCCB cover and case shall be made of high strength heat resisting and flame retardant thermosetting insulating material. Operating handle shall be quick make/break, trip - free type. Operating handle shall have suitable ON, OFF and TRIP indicators. Suitable arc extinguishing device shall be provided for each contact. Contact trips shall be made of suitable arc resistant sintered alloy.

Protective Release

All MCCBs upto 125A shall have Variable Thermal (O/L) & Fixed Magnetic (S/C) protection settings.

All MCCBs above 125A & upto 200A shall have Variable Thermal (O/L) & Variable Magnetic (S/C) protection settings.

All MCCBs of 250A and above shall be of Microprocessor Based with adjustable Overload, Short Circuit and In-Built Earth Fault Protection.

In case of 3 Phase 4 Wire Systems, if 3 Pole MCCBs are specified then Vendor should provide Neutral CT from MCCB Manufacturer.

For Motor application, motor duty type MCCBs shall be selected with reference to Type 2 coordination chart provided by the manufacturer.

MCCBs used in the main MV Panel shall have provision for LCD display. The display shall be mounted on the panel door. Current metering and trip data should be seen on the display.

MCCBs used in Outgoing feeders of Main panel and incomers of downstream sub-panels shall be suitable for Total Selectivity. These MCCBs shall be selected as per Manufacturer's recommendation.

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick

break, trip-free type. The operating handle shall be simultaneous operation and tripping of all the three phases.

Suitable fire extinguishing device shall be provided for each contact. Tripping unit shall be of thermo magnetic type up to 250 A for adjustable overload & short circuit protection and shall be microprocessor type above 250 A for adjustable overload, short circuit & earth fault protection. MCCB shall be line load reversible type. Device shall have IDMT characteristics for sustained overload, and short circuits. MCCB shall be current limiting type.

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

Rupturing Capacity

The Moulded Case Circuit Breaker service breaking capacity (Ics) shall be based on actual calculation.

Testing

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished. Pre-commissioning tests on the sub distribution boards incorporating the MCCB shall be done as per standard.

5.15. SURGE PROTECTION DEVICE

General

The Internal Surge Protection Device shall be selected as per zone of protection described in IEC 62305, 61643-11/12/21, 60364-4/5. Depending on Zone concept of provided in IEC 62305 – 1 & 4.

LPZ -OB & LPZ 1: At Mains entry point (Main LT Panel): Type 1 + 2, i.e.

SPD Combined Arrester with Integrated Backup Fuse.

Power Line Protection

Main Distribution Board shall have Type 1 SPD to discharge Lightning current surges for 415 V AC, 3 phase 4 wire (TT) configuration. UPS / Sub Distribution Board shall have Type 2 SPD to discharge switching surges for 415 V AC,

3 phase 4 wire (TT) configuration. Server and sensitive equipments shall have Type 3 SPD at their power input to discharge switching surges.

Type 1 and Type 2 devices shall be from same manufacturer to achieve the co-ordination.

Type 1 (At Main Lt Panel)

a) The device shall be non-exhausting metal encapsulated, spark gap based technology and tested as per latest and valid IEC 61643-11:2011 or EN 61643-11:2012 standards. It shall have integrated fuse protection.

b) The device shall be capable to discharge Lightning current (10/350μs) of 25kA (L-N) and 100kA(N-E).

c) The device shall have voltage protection level of device shall be ≤ 1.5 KV including inbuilt fuse for L-N.

d) The device shall have Follow current extinguishing capability [L-N]/[N-PE] : 100kArms / 100Arms

e) The device shall have built in fuse and operation of SPD shall be independent of Line current for L-N SPD. The short circuit with stand capability of the device shall be 100 KArms for L-N SPD.

f) The device shall have mechanical indication for both the states (green for 'healthy' and red for failure) on L-N and N-PE.

g) The device shall be certified by KEMA or VDE or NABL lab as per IEC 61643-11:2011 or EN 61643-11:2012 for testing of all parameter at 10/350 μs and 8/20 μs.

5.16. MEASURING INSTRUMENT FOR METERING

General

The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

Digital Ammeters

Digital Ammeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

Digital Voltmeters

Digital Voltmeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

MFM Meter

Digital MFM shall be confirmed to ISO:62053. Multi-Function Meter used in electrical panels. These meters are designed to measure various electrical parameters such as voltage, current, power (active, reactive, apparent), energy consumption, power factor, and frequency.

They are commonly used in industrial, commercial, and sometimes residential settings to monitor and manage electrical usage, ensuring efficient operation and sometimes for billing purposes in larger installations.

Current Transformers

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 15A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

Measuring : Class 1.0

Protection : Class 5 P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault on medium voltage system. The fault level of CT shall be same as fault level of panel. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Control Switches

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

Cable Termination

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

Control Wiring

All control wirings shall be carried out with 1100V grade single core PVC cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

Terminal Block

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

Labels

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

Miscellaneous

Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

Battery and Battery Charger

A set of 24V DC power supply shall be provided for indication, relay operation etc. for Main L.T.Panel. DC Power supply shall be sealed maintenance free batteries of suitable capacity. Suitable battery chargers shall also be provided to charge the battery to perform during mains failure.

5.17. APFC PANEL

Scope of Work

This specification covers the technical requirements for Design, Engineering, Manufacture, Testing at Works, Supply at Site, Install, Test & Commissioning of 415V APFC Panel, Complete with all accessories for efficient and trouble – free operation.

Standards

The equipment covered by this specification shall, unless otherwise stated, be designed, constructed and tested in accordance with the latest revisions of relevant Indian Standards and shall conform to the regulations of local statutory Authorities.

IS:722 A.C. electricity meters

IS:732 Code of practice for Electrical wiring installation.

IS:375 Marking and arrangement for switchgear Busbar main connections and auxiliary wiring.

IS:1248 Direct acting electrical indicating instruments.

IS:13947 LV Switchgear and Control Gear.

IS:2705 Current Transformers.

IS:3231 Electricity relays for power system protection.

IS:8623 Specification for factory Built assemblies for Voltages. Upto 1000V A.C. and 1200V.D.C

IS:4237 General requirement of switchgear and Controlgear for Voltages not exceeding 1000V.

IS:2959 AC Contactors for voltage not exceeding 1000V.

IS:162 Specification for Electric Power Switchgear and Associated apparatus.

IS:2834 Capacitors.

The panel supplied shall satisfy all the requirement of Local Statutory authorities and modification if any required site shall be carried out by the Contractor without extra cost.

5.18. CONSTRUCTION

General

The panel shall be metal-enclosed, free standing, modular type, suitable for indoor installation. The panel shall be dust and vermin proof and the enclosure shall provide a degree of protection of not less than IP-52.

The fabrication shall be rigid, robust, flaw less and shall have a smooth finish.

The board shall be fabricated out of 3mm thick mild steel structural sections. The frames shall be enclosed with steel of not less than 2.0mm thickness. The internal partition shall of 1.6mm thick.

The panel shall be extensible type.

Each capacitor shall be provided with a fast acting controller which shall be capable of a very fast response.

Due consideration shall be given to the following during design of the panel and locating the various components viz. Circuit Breakers, Instruments & Relays, Busbar, Capacitors and secondary wiring.

Facility for inspection, maintenance & repair Minimum vibration and noise.

Risk of accidental short circuit, open circuit and damage to personnel

due to accidental contact with live parts.

Inter charge ability of components.

Secure and vibration proof connection for power and control circuit.

Shrouding of all live parts in feeder component and cable chamber.

All retaining catches, Screws and bolts for doors and covers shall be zinc passivated. Screws and bolts shall be captive. All covers, doors and joints shall be gasketted.

Equipment to be mounted outside cubicles shall be flush mounted on cubicle door. No.externally mounted equipment shall be mounted above 1.9m or below 0.4m from floor level.

All components including ACB/MCCB/Contractor shall be of same make.

Control Circuit shall be protected by MCBs and not by fuses.

BUSBARS

The busbars shall be air insulated and made up of EC grade aluminium alloy equivalent to E91E WP as per IS 5082, 1981.

The busbars shall be TP and N, the section of the neutral bus being half the size of the phase busbar.

The busbar shall be provided with proper grade & colour of heat shrinkable PVC sleeve with colour strips of red, yellow, blue and black and the same shall be arranged in accordance with IS-375.

The busbar shall be properly segregated, suitable braced with insulated supports (SMC) placed at appropriate intervals to withstand the electro magnetic stresses during short circuit.

Minimum electrical clearances shall be maintained between phase, neutral and body as per standards.

The insulation used shall be non – hygroscope and shall be treated for preventing fungus growth.

5.19. INTERCONNECTION

For each and every tapping from the busbars, separate connections shall be made. No direct tappings from the busbar shall be made for any feeder without control and protection.

All interconnections shall be by rigid busbars only.

Wherever lugs are used for terminated of rigid busbars, it shall be soldered and not crimped.

5.20. AUTOMATIC POWER FACTOR CORRECTION

Due to high load fluctuation, automatic control of power factor by capacitors shall be provided to achieve, as far as possible, a power factor of 0.95 lagging.To achieve the present desired power factor, suitable micro processor based reactive power controller to switch ON and OFF the regulating stages shall be provided in the panel.The capacitor shall be sub divided into regulating stages as specified.. In case of supply interruption, the zero voltage relay shall be provided to reset the control devices to their neutral position as that on restoration of supply, the capacitor stages are switched on again stage by stage, thus preventing any undesirable current voltage peak.

APFCR Relay

The APFCR relay shall be micro processor based and shall be suitable for controlling capacitors in number of stages as specified. The Relay shall be acceptable of accepting kVAR ratings of the banks in any random denomination with Measurement sensitivity of 1%..

The relay shall be suitable for three phase or single phase current sensing as specified in the BOQ.

The relay shall have Field settable target power factor, on/off delay, CT ratio and will constantly monitor the kVAR compensation required and select the right combination of banks to ensure that the plant PF is maintained very close or equal to the set value.

The relay shall have seven segment super bright LED or backlit LCD panle to display PF, KW or KVAR, Voltage and Current.

The relay shall have fault/Alarm indication for Over / Under Voltage, Over / Under Frequency, Over / Under compensation and under current, CT polarity

Reversal.

The relay shall be provided with field selectable Auto / Manual Mode for control of capacitor banks.

Capacitor

The dielectric system shall consist of metallized polypropylene film. The dielectric shall be wound to form a winding and shall be impregnated with non-PCB oil/flexible epoxy. The metallising shall be done either by aluminium or zinc. The dielectric shall have self healing properties.

Each capacitor unit shall be provided with inrush current limiting devices within the container. The capacitors shall be enclosed in heat proof, dust proof, water proof containers.

Permissible tolerance of capacitor

a. Operating Voltage	:	440 Volts +1-10% Max.
b. Output KVAR	:	-5% to +10%
c. Measured loss angles	:	+10%
d. Line Current	:	+30% (including transients)
e. Losses	:	<0.5KW per KVAR.

Note:

The discharge resistor contained in the capacitor unit shall reduce the residual voltage to 50 Volts or less than within 5 minutes after the capacitor unit is disconnected from the source of supply.

Measuring Instruments

Digital MFM shall be confirmed to ISO:62053. Multi-Function Meter used in electrical panels. These meters are designed to measure various electrical parameters such as voltage, current, power (active, reactive, apparent), energy consumption, power factor, and frequency. They are commonly used in industrial, commercial, and sometimes residential settings to monitor and manage electrical usage, ensuring efficient operation and sometimes for billing purposes in larger installations.

Control Wiring

Panel shall be supplied with all internal wiring comprising of PVC insulated 1.1 KV grade, mufti stranded flexible copper conductor of 1.5 sq.mm cross section.

Wiring associated with a particular phase shall be the colour of that phase viz. Red / Yellow, or Blue, wiring associated with earthing shall be with green colour insulation and for neutral it shall be with black colour insulation.

Wiring shall be neatly laid and run on insulated cleats of limited compression type insulated straps.

All cables shall have crimped terminations and shall be identified by means of glossy plastic ferrules at both ends, showing the wire number as indicated in the schematic diagrams. The ferrules shall be indelibly marked.

Wiring to items mounted on hinged doors or wiring that is subject to movement, shall run in helical binding. The binding shall be securely anchored at both ends and sufficient slack provided to prevent any strain being imposed on wiring.

Earthing

All the metal parts of all equipment supplied within the panel (including doors and gland plates) other than those forming part of all electric circuit, shall be connected by means of two independent earth conductors to continuous copper earth bar of size25 x 3 mm running

along the full length of the panel. The panel shall be provided with two brass earthing stud terminals, with suitable nuts, washers etc. for connection to ground bus.

Terminal Block

The Terminal Blocks shall be 650V grade, multiway terminal blocks of non-tracking moulded plastic complete with insulated barriers, stud type terminals, washers, nuts and lock nuts and identification strips. Power and control terminals shall be segregated. Control terminals of minimum rating 10 amps suitable to receive 2.5 sq. mm copper conductor.

20% spare terminals in each control terminal block shall be provided. Not more than two wires shall be connected to any terminal block.

Labels

Labels shall be provided to describe the duty of or otherwise identify every Instrument, or other item of equipment mounted internally and externally. Switch positions shall be fully identified. Wording shall be clear, concise and unambiguous.

Each label shall be permanently secured to the panel surface below the item to which it refers.

The labels shall be engraved in plastic with white letters in black background.

In addition to component labels, each cubicle door shall bear a large identification labels and the panel shall include large, prominent overall identification label.

Cable Compartment

Ample space for connection for incoming cables shall be provided at the rear of the switch board. In order to avoid accidental contact in the cable compartment while carrying out inspection by opening the back cover, a removable expanded metal barrier shall be provided in the cable compartment. The various cable sizes shall be as indicated in the Bill of Quantities.

Cable lugs and the requisite bushes for sealing power cable entries shall be included in the scope of supply of the switch board.

The head room available between cable gland plate and terminal shall not be less than 750 mm.

In case cable termination cannot be accommodated inside panel a suitable box for mounting at bottom / rear of panel shall be supplied by vendor. Each strip shall also be brought to this box.

5.21. PAINTING

Care shall be taken in workmanship and selection of materials to prevent the occurrence of any form of damage or corrosion due to damp or humid conditions.

The Board shall be prepared, primed, filled and painted to the highest standards.

All items shall be cleaned and deburred, after fabrication and welding is completed. External surfaces shall be filled and rubbed down as necessary to obtain a perfectly flat smooth surface, free from blemishes and imperfections.

The painting process shall be using a seven tank phosphating system with primer coating within 4 hours of phosphating and two coats Epoxy Powder Coating.

The paint shall not rust especially in comers and holes.

Tests

The panel shall be completely assembled, wired, adjusted and tested for operation under simulated conditions to ensure accuracy of wiring, correctness of control scheme and proper functioning of all equipment.

Routine Test

1. Mechanical operation test
2. Dielectric tests

Drawings and Documents

The following drawings and documents shall be furnished.

a. General Arrangement drawing of the panel showing.
   i. Overall Dimensions
   ii Terminal locations
   iii. Total weight
   iv Foundation details
   v. Sectional view
   vi. Bill of materials

b. Single line diagram and wiring diagram.

c. Technical details for Switchgear, lamps, meters etc.

d. Manufacturing schedule and test schedule,

e. Calculation for sizing of bus bars.

5.22. TECHNICAL REQUIREMENTS FOR APFC PANEL

SL NO	DESCRIPITION	SCOPE/VALUE

1	Application	Indoor
2	Type	Cubicle, Metal enclosed free Standing
3	Degree of Protection	IP 52
4	Rated Voltage	433V
5	Rated Short Circuit Current	35KA
6	Design Ambient Temperature	45℃
7	Temperature rise over ambient Temperature	40℃
8	Busbar	
A	Number Phase/Wires	3 Phase, 4 Wire
B	Continuous Current	As specified
C	Frequency	50 Hz
D	Fault Level	As specified.
E	Material	Copper/Aluminium as specified.
9	Earthing	
A	Material	Copper
B	Size	25 x 3 mm
10	Insulation Level	
A	Power Frequency withstand Voltage	3KV
11	Painting	Epoxy Powder Coated
12	Control Voltage	230V AC/220V DC
13	Control Wiring	
A	C.T. Circuits	2.5 Sq.mm Cu. Multistranded
B	Others	1.5 Sq.mm Cu. Multistranded
C	Voltage Grade	660V/1100V
14	Reference Standard	IS: 8623

Warranty/Guarantee:

Products Warranty/Guarantee will be a period of 18 months from the date of Dispatch and commissioning as per manufacture defects.

11KV HT CABLE & LAYING

General

The cables shall be supplied, inspected, laid, tested and commissioned in accordance with Drawings. Specifications, Indian Standard Specifications IS: 7098, Part-II IS: 1255- 1967 and cable manufacturer's instructions. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

Material

The H.T. cables shall be 11KV, aluminum conductor XLPE insulated, galvanized flat strip armoured, inner and out sheath of FRLS PVC, cable laid underground and or in masonry trenches as shown in Drawings. The conductor shall be made of Electrical purity Aluminium wires and stranded together and compacted. The cable shall be of 1/ 3 Core type. The insulation shall be of high quality XLPE, as per IS: 7098 Part-II applied by extrusion process. Armouring is applied over inner sheath and shall be of galvanized flat strips. The inner and outer sheath shall be of FRLS PVC. This shall be of black colour.

Inspection

All cables shall be inspected upon receipt at site and checked for any damage during transit.

Joints In Cables

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of jointing cable. This cable shall be got approved from the Engineer In-Charge before the cables are cut to lengths. Where joints are unavoidable, the location of such joints shall be got approved from the Engineer-In-Charge.

Jointing Boxes For Cables

Cable joint boxes shall be of appropriate size, suitable for Aluminium conductor XLPE/FRLSH insulated cables of 11KV ratings.

Jointing Cables

All cable joints shall be made in suitable, approved cable joint boxes. Jointing of cables shall be done in accordance with the best practice in trade, in accordance with IS.

All cables shall be jointed color to color and tested for continuity and insulation resistance before jointing commences. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection for the weather shall be arranged. Joints shall be made by means of suitable solder for conductors, the conductors being firmly butted into the connections or thimbles or ferrules and the whole soldered with proper solder and soldering flux or resin. The conductors shall be efficiently insulated with high voltage insulating tape and use of spreaders of approved size and pattern.

The joints shall be completely filled with epoxy compound being topped as necessary to ensure that the box is properly filled.

Cable Terminations

Cable termination shall be done with heat shrinkable jointing kit complete with accessories and lugs suitable for the cable.

Bonding of Cables

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that in the event of ground movement no undue stress is passed into the cable conductors.

Laying of Cables

H.T. cables shall be laid either buried directly underground or in Masonry/Concrete trenches/ RCC/Hume/Metal Pipes . The cable shall be laid underground as per CPWD's General Specifications for Electrical Works Part-II External -1994 . Sand cushion of not less than 25 mm shall be provided both above and below the cable with mechanical protection of second class brick of size 22 Cm X 11.4 Cm x 7 cm placed on top of sand . The cable trench shall be back filled and compacted and surplus earth will be disposed off as per direction of Engineer-In- Charge,

All cables shall be laid as per Latest C.P.W.D General Specifications for electrical Works (Part-IV Substation) - 2013 with all upto date amendments.

Protection of Cables

The cable shall be protected by placing precast reinforced 50mm, thick (1:2:4) concrete slab 200mm wide on the top layer of sand for the length of the cable. Where more than one cable is running in the same trench, the concrete blocks shall cover all the cables and shall minimum 80mm on either side of the cables.

Cables under road crossings and any surfaces subjected to heavy traffic, shall be protected by running them through Hume pipes of suitable size.

Route Marker

Route Markers of RCC or CI shall be provided along the cable laid in ground at regular interval and at all turnings.

Testing of Cables

All cables shall be tested as per Latest C.P.W.D General Specifications for electrical Works (Part-IV Substation) - 2013 with all upto date amendments.

5.23. II EXTERNAL LIGHTING WORK

External Light

Bollard LED 8-10 Watt Architectural bollard LED 3000K 230-240Vac 50-60Hz CRI > 80 Input power: 8W Height 800mm, Electronic driver ON/OFF CE and RoHS compliance TYPE: Bollard, IP rating IP65, impact resistance IK10. MATERIAL CHARACTERISTICS : Extruded aluminium bottom pipe Ø100 x H800mm with polycarbonate diffuser and integral base plate Ø180 with PG gland. Luminaire contains built in LED modules. Operating ambient temperature range is from -20°C to +40°C. Lumen output 300 lm, light source 96 power LEDs. Resistance to heat and fore for plasticpart should be 850 degree celcius. Housing Color Dark grey RAL 7043. CCE, CE and RoHS compliance.

Bollard LED 8-10 Watt Lighter

Gate Light shall havevcircular LED post having housing made of pressure die-cast aluminium (including top canopy & pole mounting piece) with integrated optics & having Polyester powder coating in addition to a specific weathering resistance treatment. The dia of the post top shall be of the post top shall be minimum 450mm & height of minimum 200mm (including the pole mounting piece). The colour shall be RAL 7011 textured. The post top shall have Non-yellowing transparent and textured polycar bonate diffuser, 1.5mm thick. It should have concentric circular radial pattern for reduced glare & even light distribution. The luminaire must have round symmetrical optics/distribution. The luminaire shall be IP66 rated (without any glue) & shall have IK10 rating. The luminaire shall use high performance LEDs having CCT of 3000K/4000K/5700°K/6500K, CRI≥ 70 & SDCM ≤ 5. The luminaire shall deliver initial system lumen output of minimum 5000lumens & must have system luminous efficacy ≥110lm/w. The luminaire shall have Class-I electrical insulation & Serviceability of Class-B. The luminaire shall use BIS registered electronic driver having voltage range of 122V-277V with in-built surge protection of 4KV, THD≤10%. The driver shall have high cut-off (>325V±15V) & auto restart. The luminaire shall have in-built additional SPD of 10KV. The pole mounting piece shall be suitable for mounting on pole dia of 60mm. The luminaire shall be BIS registered. Luminaire manufacturer shall have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322.

Gate Light shall have v circular LED Lighter

10 W LED round LED post top light fixture suitable for mounting on 3-4 mtr pole, housing made up of High-quality Pressure die-cast aluminum housing LM6 alloy (Excellent corrosion resistance and robustness) with UV protected Polycarbonate cover comes with IK08 protection, sturdiness and embossed brand name/logo name of manufacturer. The fixture should have high power LED with minimum system efficacy of 115 lumen/Watt and a minimum system lumen output of 4000 lumens, CCT of 5700K & CRI 70, PF >0.95 & THD<10%. The fixture & LED Driver shall be designed for a system life of 50,000 hours @70% lumen maintenance. Ingress Protection of IP66 (lamp and gear Compartment) and Mechanical Impact Resistance Rating of IK10.The fixture driver should have an operating voltage range of 120-270V with Auto Restart, High Cut off (>325V), Auto Restart, surge protection of >=4KV Internal. Fixture & LED driver should be of same make. LED Fixture & LED Driver must have BIS. Luminaire manufacture shall provide LM79 report from NABL/UL accredited lab.

10 W LED round LED Post Top Lighter

12Mts High Mast LED

Mast Structure

The high Mast shall be of continuously tapered, polygonal cross section polygon type of 12 Mtrs in height presenting good visual appearance and shall be based on proven design to given assured performance, reliability and service. The Mast shall have an approximate top diameter of say 150 mm to 200 mm and bottom diameter of 350 mm to 450mm. The weight of the Mast shall not exceed more than 1600 kgs. Excluding weight of Luminaire, to maintain good elasticity of slender structure.

High-Mast Lighter

Mast construction

The Mast shall be fabricated from special steel plates of BS EN 10025 grade, cut and folded to form polygonal section and shall be telescopically jointed and fillet welded. The welding shall be in accordance with BS : 5135. The procedural weld geometry and the workmanship shall be exhaustively tested by the radiography on the completed welded and certificates submitted.

The Mast shall be delivered in only 2 sections without any circumferential welding at site, which shall be joined together by slip-stressed-fit method. The joining shall be with stressing equipment, thus forming the sleeve joint. No site welding or bolted joint will be accepted. The overlap distance shall have full penetration of longitudinal welds. The base plate of the mast shall be atleast 25mm. thick. An adequate door opening of min. 1400 mm x 300 mm shall be provided at the base of each Mast. The opening shall be such as to permit clear access to equipment like winches, cable pug and socket, etc. The opening shall be complete with a close fitting vandal resistant, weather- proof door provided with a heavy duty lock. For metal protection of the Mast, the entire fabricated Mast shall be not dip galvanised internally and externally,having minimum average thickness of 65 microns.

Dynamic Loading

The Mast structure shall be designed for an assumed maximum reaction arising from the maximum win speed (3 seconds gust) and measured at a height of 12 Mtrs. above ground level as per IS 875, Part III, 1987. The design life of the Mast shall be min. 25 years. Wind excited oscillation shall be damped by the method of constructions and adequate allowance made for the related stresses. The offered High Mast shall be a tested design.

Foundation

The Contractor shall see the site closely and minutely with regard to the nature of the soil, average depth of decomposed garbage and debris at proposed Mast locations and the other site conditions before working out the type of foundation and specifications for the proposed High Mast to the manufacture standared. The Contractor/Manufacture shall be responsible of the foundation and safe erection and installation of the High Mast in mechanically and structurally safe working condition for the designlife of the Mast. The load bearing (safe) capacity of the soil shall be indicated by purchaser to decide the type of foundation and its specifications. The holding down bolts shall be at least 20 nos. of high tensile strength and shall be supplied complete with anchor plate of 6 mm thick for casting into the foundation. The precision made steel template with tube holes shall be provided to ensure correct verticality and horizontality of bolt alignment.

Lantern Carriage

The fabricated lantern carriages shall be provided for holding the floodlight fittings and control gear provided on each High Mast. The lantern carriage shall be of special design and of durable steel tube construction designed to act as electric conduit with cable holes fully protected by grummets. The diameter of the lantern Carriage shall be suitabe so as to hold

designed number of floodlight fittings, as specified in the tender design along with the control gear boxes and lantern.

The lantern carriage shall be fabricated in three parts joined by bolted flanges with SS bolts with nuts to enable easy removal from the erected mast for replacement/ maintenance purpose. The carriage shall be supported / suspended by three wire ropes for better stability. The lantern carriage Assembly shall not touch the lower surface of the Mast. The carriage design and fabrication shall be such that the lantern carriage will suit the lanterns and their control gear boxes to be used in the work.

The Lantern Carriage shall be so installed that it does not cause any damage to the surface of the Mast and is provided with protective buffer arrangement. The complete Lantern Carriage shall be hot dip galvanised after fabrication.

The weather – proof cast aluminum junction boxes (IP-55) shall be provided on the Lantern Carriage assembly from which the inter – connections will be made to the designed number of floodlight fittings and lanterns on the carriage.

Mechanical Arrangment

For installation and maintenance purpose, it will become necessary to raise or lower the lantern carriage assembly. To enable this, a suitable winch arrangement shall be provided in the base of the Mast, complete with top pulley, winch stainless steel wire ropes and winch driving power tool.

Winch

The winch shall be of completely self – sustaining type. The winches shall be of self – sustaining type by means of an oil bath and the lubrication shall be of recommended quality. Termination of the ropes of the winch shall be in such a way, that it does not involve distortion or twisting of the rope configuration. At least 6 turns of rope shall remain in tension on the drum even when the lantern carriage is fully lowered. The winch shall be designed to be installed or removed form the door opening at the base of the mast. The winch drums shall be grooved to ensure mechanically strong, stable and tidy rope lay with no chances of rope slippage or skip page. The winch shall be capable of operation by hand or by means of external power tool. Integrated power tool with worm is not acceptable.
A test certificate shall be supplied along with each winch in support of the maximum load operated by the winch and for the safety of operation at the full load rotation. A handle shall also be provided for hand operation of the winches.

Top Pulley Assembly

The top pulleys shall be of a diameter, appropriately large enough to accommodate the steel wire ropes and the muiticore electric cable. The material of construction of the pulley blocks shall be non – corrosive and made of dia cast (LM - 6) aluminum alloy. The pulley assembly shall be complete with self lubricating bearing and stainless steel spindle.

Stainless Steel Wire Ropes

Stainless steel wire ropes shall be of 7 / 19 construction of 5 mm diameter, having a breaking load of not less than 1350 kgs. Complete with stainless steel thimbles. The end for connection to the winch drum shall be fitted with thimbles and the thimbles shall be secured by copper compression splices.

Cable and Cable Connections

The connections shall be made with flat core flexible round sheath power cables of appropriate rating as per the schedule. The base compartment of the High Mast shall have one terminal box for terminating the incomer cable. The maintenance cables equal to that within the Mast and fitted with a 5 core plug socket shall be provided to energise lanterns while in lowering position by hooking up at the base compartment socket supply. Similarly, the provision shall be made for electric supply at the base compartment to enable operation of the external power tool for lowering or rising of the lantern carriage assembly. The trailing cables of the lantern carriage rings shall be terminated by means of metal cased plug and socket provided in the base compartment to enable flexibility.

Winch Driving Power Tool

The electric driven tool shall be single speed, (1.2 Mt./min.) reversible three phase & hand operated motor. The power tool shall be complete with very robust remote control switch such that the tool can be operated from safe distance of 5 Mtrs. There shall be an arrangement for self alignment off power tool which can be self supported during operation. Manual handle shall be provided for hand operation of the winches. The capacity rating and speed of the electric motor used in the power tool shall be specified by the tenders.

Lighting Final & Aviation Obstruction

One number heavy duty hot dip galvanized lighting finial shall be provided for each mast. Suitable Aviation Obstruction Lights of reliable design and reputed manufacturer shall be provided on top of each mast.

200-watt FLOOD LIGHT

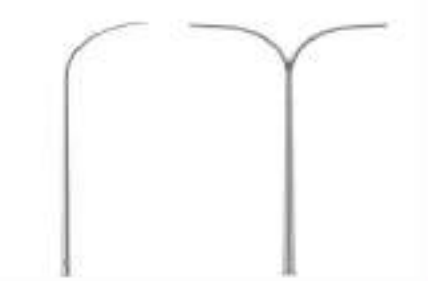
200-watt FLOOD LIGHT

Glatt a high-performance floodlight(200watts) with pressure die cast IP66 housing,secondary

lens with 120 lm/W efficiancy and superior aesthetics suitable for various application.

Meter Height Hot-Dip Galvanized Tube Street Light Pole

The 6 mtr high hot dip galvanised Tube poles with 155mm bottom A/F & 70mm top A/F made up of 3mm thk. HR sheet alongwith base plate of size 250X250X16mm thk, 1 m long hot dip galvanised standerd bracket made up of 48 Outer dia. GI pipe suitable to mount on pole having top 70mm A/F with 4Nos of M24X750 long 'J' type EN 8 grade foundation bolts along with template.



Galvanized Tube Poles

70 Watt LED type Street Light

The 70 watt LED type street light with a nominal system lumen output of 5400 lumens and .a minimum system efficacy of 100 lumen/watt. The luminaire shall have rated system lifetime of 50,000 burning hours at L70B50. The luminaire should have CCT 3000K/4000K/5700K/6500K and a CRI>70, SDCM<5. The luminaire shall meet IP66 and IK07 rating with THD<10% at full loa4, Wide operating Voltage(CLO) 100-270VAC, & PF>0.95 at full load and PF>0.9 at half load, electrical insulation class 1, interface to mains should be via 3C 1 .0sq.mm,0.5m-fying cable, T ambient 35°C. Inbuilt surge protection 4KV. The luminaire housing should be made of pressure die cast aluminium, lens and optical cover should be made of PC window. The total power consumption should not exceed 54W (including driver). The luminaire should have HV Cut off @ 325V/440V protection for 8 hrs. LM 79 and LM80 reports need to be submitted from a NABL/UL accredited lab to verify above parameters.

70 watt LED type Street Light Lighter

Warranty/Guarantee as per manufacturing defects

5.24. FEEDER PILLAR (OUTDOOR TYPE)

General

Feeder Pillar shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type totally enclosed free standing type moisture, dust, vermin & weather proof outdoor type Floor Distribution Panel made out of 2.0mm thick & front cover 1.6mm thick CRCA sheet complete with following equipments, including digital ammeter with inbuilt ammeter selector switch, digital voltmeter with inbuilt voltmeter selector switch, indicating lamps, CT's, internal wiring with suitable size wires / cable. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.This outdoor pillar box will be utilised for providing/interconnecting MVAC distribution network.

Applicable Standards

a) IS 5039-1983: Specification for distribution pillars for voltages not exceeding 1000V AC &1200V DC.

b) IS 13703 (Part-1&2)-1993 / IEC 60263/1-1986: Specification for LV fuses for voltage not exceeding 1000V AC & 1500V DC.

c) IS 12063-1987 / IEC 60529: Classification of degree of protection provided by enclosure of electrical equipment.

d) IS 13947 (Part-1) / IEC 60947/1-1988: Specification for LV switch gear &control gear.

e) IS 8623 (Part-2)-1993 / IEC 60439/2-1987: Specification for LV switch gear & control gear assemblies – particular requirements for Bus bar trunking system.

f) IS 2551-1982: Danger Notice Plates.

g) IEC 60664: Insulation co-ordination within low voltage systems including clearance cree page distances for equipment.

h) IS 2147:Enclosure & Degree of protection of the Pillar Box

i) IS 6005: Code of Practice for phospating iron and steel

j) IEC 60269 : HRC Fuses

Climatic Conditions of the Installation

a) Max. Ambient Temperature : 42 deg. C

b) Min. Ambient Temperature: 10 deg. C

c) Max. Humidity : 98%

d) Min. Humidity : 60%

e) Average Annual Rainfall : 2500 mm

f) Average No. of rainy days per annum: 150 days

g) Altitude above MSL : 6 metres

h) Average wind velocity: 18 km/hr

General Technical Requirement

Sl.No	Description	Requirement
1.	Installation	Outdoor
2.	Rate Voltage	430V
3.	No. of Phases	3
4.	Frequency	50 Hz
5.	Wiring System	3 Phase 4 Wire
6.	System Earthing	Solid at source end.
7.	Impulse withstand voltage	8 kV
8.	Rated short time fault current	50 kA for 1 sec.
9.	Busbar Material	
	6 way (2 I/C + 4 O/G)	Aluminium (75 X 12) mm dimension.
	8 way (2 I/C + 6 O/G)	Aluminium (100 X 12) mm dimension.
10.	Max. current density of Al-Busbar	1 Amp/sqmm.
11.	Degree of Protection	IP-43
12.	Temperature Rise	Max. permissible temperature rise for the Busbar and terminal should be 45°C & 65°C respectively at ambient not exceeding 42°C
13.	No. of Incoming unit with solid link	2
14.	No. of Outgoing unit with fuse link	4 for 6 Way, 6 for 8 Way Pillar box
15.	Type of Incoming Fuse-Link / Fuse Base	Knife type Solid Links with tinned copper contacts & fuse base with high stability glass fibre reinforced thermosetting polyester.
16.	Type of Outgoing Fuse-Link / Fuse Base	Knife type DIN HRC Fuses with tinned copper contacts & fuse base with high stability glass fibre reinforced thermosetting polyester.
17.	Type of Incoming Solid-Link / Base	Knife type solid link with tinned copper contacts & base with high stability glass fibre reinforced thermosetting polyester. However for 4 Way PB there won't be any solid

Sl.No	Description	Requirement
		link and all the units should have fuse link.
18.	Fuse Base Rating & Size	
	6 way	630 Amps (Size-3)
	8 way	1000 Amps
19.	DIN HRC fuse Rating & Size	315 Amps (Size-3)/400 Amps (Size-3) depending upon site selection.
20.	Current rating of Busbar	
	6 way (2 I/C + 4 O/G)	900 Amps
	8 way (2 I/C + 6 O/G)	1200 Amps
21.	Busbar spacing (centre to centre)	185 mm
22.	Neutral Busbar rating	
	6 way (2 I/C + 4 O/G)	900 Amps
	8 way (2 I/C + 6 O/G)	1200 Amps
23.	Size of Incoming Cables	2X 4C X 300 sqmm.
24.	Size of Outgoing Cables	4C X 185 sqmm.
25.	Pillar box dimension	1400 X 1200 X 415 mm.
	6 way (2 I/C + 4 O/G)	1400 X 1400 X 415 mm.
	8 way (2 I/C + 6 O/G)	1400 X 1200 X 415 mm.
26.	PB Leg dimension	910 mm X 4 (made of 75X75X 6 mm angle iron)
27.	Enclosure material	Cold rolled steel of 3.15 mm thickness
28.	Colour of enclosure	Light Grey 631 of IS:5

NB.: Suitable Correction factor and Diversity factor as per requirement of IEC/EN 61439-2 are to be followed during designing the assembly within the PB enclosure.

Tests

Type Tests: On Complete Pillar Box

The equipment should have been successfully type tested at NABL laboratories in India or equivalent international laboratories in line with the relevant standard and technical specification.

The list of type tests is as follows

Following type tests as per IS: 5039/1983 shall be carried out on complete L.T. feeder Pillars.

1. Temperature rise test:-The temperature rise test should be carried out as per IS: 8623-1993.
2. High voltage test shall be carried out as per IS: 8623/ 1993 amended up to date.
3. Short Time Withstand Current Test on L.T. Pillar shall be carried out as per IS 8623: or latest version.
4. Degree of protection for IP- 43 on complete L.T. Pillar shall be carried out as per IS: 13947/1993 or the latest version thereof.
5. Verification of clearance & creepage distances.

Acceptance Test: On Complete Pillar Box

Following tests shall be carried out as per acceptance tests in addition to routine tests on one random sample of each rating out of the lot offered for inspection:

Temperature rise test on one sample of each rating.

Routine Tests: On Complete Piller Box

a) Routine and acceptance tests as per relevant IS shall be carried out at the manufacturers' works.
b) Overall Dimensions Checking.
c) Insulation Resistance Tests.
d) High Voltage Test at 2500 V, 50 Hz AC for one minute.

5.25. ADVANCED LIGHTNING ARRESTER

General

The lightning protection system shall be of the enhancing type designed to attract lightning from a predetermined volume and to safely convey the lightning current to earth through a known and preferred route.

The lightning protection system shall include components as follows: air termination(s) mechanical support(s), down conductor(s), performance recording equipment, and an earthing system.

The lightning protection components (Air termination(s) and down conductor(s)) shall be compliant to UL-96.

Air Termination

The air termination shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons and photo-ionisation between a spherical surface and an earthed central finial.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader. Arcing shall not occur solely due to electrostatic field when a thunderstorm is overhead except when there is leader activity in the region.

The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The air termination shall be non-radioactive and require no special licensing.

The external shape of the terminal shall be such as to significantly reduce the build up of sharp point corona discharge under static field thunderstorm conditions.

The air termination shall not be dependent upon batteries or external power supplies for any part of its operation. It shall have no moving parts.

The materials of the air termination shall be non-corroding in normal atmosphere. The centre earthed finial shall be at least 300mm² in cross section and be made of electric grade non ferrous material. The outer metallic surfaces of the terminal shall be manufactured of anodised aluminium.

The air termination shall be insulated from the protected structure under all conditions.

The size of the collection volume and attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.

The termination shall be mounted a minimum of 10 metres from the ground.

The air termination(s) shall be compliant to UL-96: Lightning Protection Components (Standard for Safety).

The air termination shall be installed strictly to the manufacturer's instructions. It shall not be installed in corrosive environments or atmospheres without prior written approval from the manufacturer.

The protective zone provided by the air termination shall be such that it becomes the preferred strikepoint for all discharges exceeding a peak amplitude return strike current of XX*kA according to the statistical level YYYY* of protection required. The design shall take account of upward leader competing projections on the structure.

CURRENT (XX)	LEVELS OF PROTECTION (YYYY)
3kA	Very High
6kA	High
10kA	Medium
15kA	Standard

Air Termination Support

The support shall consist of a minimum of 2 metres of insulating fibreglass cylindrical tube. The tube shall have a minimum wall thickness of 4mm and have such diameter as to allow neat in-line mounting of the terminal. The down conductor shall pass through the centre of the tube. The support shall be securely bolted to other mast materials with guy wires used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

Down Conductor

The down conductor shall consist of a plastic filler, copper conductor, inner insulation, outer copper conductor, conductive sheath, all concentrically arranged.

The outer diameter of the down conductor shall be less than 37mm.

The main copper conductor shall be made of electrical grade copper of minimum cross sectional area of 50mm².The down conductor shall have a maximum characteristic impedance of 8 Ohms and a maximum inductance of 40 nH/m.

In the final 3m to the ground and where it is exposed to human intervention, the down conductor shall be placed in a protective PVC pipe of 3mm minimum wall thickness so as to avoid mechanical damage and increase human safety.

The main copper conductor shall be capable of direct connection to the base of the air termination by use of a compression coupling.

The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to bends of less than 0.5 metres radius..

The down conductor after routing must be kept in constant physical contact with the structure via conductive clamps. The top 10% of the installed length from the terminal must be anchored at least every 1 metre. The lower must be anchored at least every 2 metres.

Impulse ratings between conductors shall be no less than 200kV, i.e: core - screen 200kV based on 1.2/50 wave shape.

The down conductor(s) shall be compliant to UL-96: Lightning Protection Components (Standard for safety)

Performance Recording Equipment

Every protection system shall be supplied with a lightning event counter.

The lightning event counter shall have an electronically controlled mechanical register which activates one registration for every discharge at the point of measurement over 1500A - 8/20ms peak current.

The lightning event counter shall be robust, easy to install and housed in a IP67 rated enclosure. It requires no batteries or external power source to operate.

The lightning event counter shall be installed to the manufacturer's instructions in a readily accessible manner so that readings can be taken at regular intervals. It shall be positioned such that it's operating temperature is in the range of -40 °C to +50°C.

Grounding

The grounding system reading shall not exceed 10 ohms static impedance except with prior approval by the specifying engineer or manufacturer of the lightning protection system.

Grounding will be done by copper wire or tape buried not more than 750mm deep or by deep driven copper bonded steel core ground rods especially designed for electrical grounding or a combination of these. In all cases the grounding system shall be electrically connected to the centre ground rod which is securely clamped to the down conductor system.

Bonding of the grounding system to metallic parts of the building, the structural reinforcing steel of the building and to arriving services is recommended. The resistance should be measured and the 10 ohms maximum figure achieved before such bonding is done.

Electrically conductive, non soluble Earth Enhancing Compounds may be used to help achieve low ground resistance provided the materials are mixed and installed strictly in accordance with the manufacturer's instructions.

5.26. III EARTHING& LIGHTING PROTECTION

Scope

This Section covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS: 3043-1987) as per relevant Indian Electricity Rules 1956 Amended upto date,shall conform to CPWD General specifications for Electrical works(part-I-Internal) 1994 and in the regulations of the local Electrical Supply Authority shall be referred to.

Application

The electrical distribution system is with earthed neutral (i.e. neutral earthed at the Transformer / Generator). In addition to the neutral earthing, provision is made for Body earthing to the metallic body of equipments and non-current carrying metallic components in the sub-station, as well as in the internal/external electrical installations such as for Transformers, HT/LT Panel, Capacitor Panels & DG Sets etc. through a common grid formed in the Substation building. Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

Each equipment shall be connected with two independent earth conductors to earth bar located in respective area. Each earth bar shall be connected to Earth Grid by two independent earth conductors. Earthing Grid shall be directly connected by two independent earth electrodes. Earthing shall be 600 x 600 x 3mm thick with copper earth plate.

Materials

The material of earth and earth conductor shall be as specified in Indicative Items.

Earth Electrodes

The type of earth electrode shall be any of the following

A. Plate/ Pipe earth electrode as specified in INDICATIVE ITEMS.

B. Electrode materials and dimensions

The materials and minimum sizes of earth electrodes shall be as specified.

Earthing Conductor

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

Neutral Earthing of Equipment

Neutral terminals of Transformers shall be earthed independently. Each neutral terminal shall be earthed with two independent earth electrodes. Earth electrode shall be 600 x 600 x 3mm thick copper plate. Copper Strip as earth conductor laid in ground shall be protected for mechanical injury & by providing GI Pipe of required dia as specified.

Plate Earth Electrode

Earthing shall be provided with copper/GI plate electrode as mentioned in Indicative Items of following.

i Copper Plate Electrode : 600mm x 600mm x 3mm thick

ii GI Plate Electrode : 600mm x 600mm x 6mm thick

The electrode shall be buried in ground with its faces vertical and not less than Three(3) metres below ground level. 40mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cast iron MS frame with cover having locking arrangement shall be provided at top of chamber. Earth electrode may not effect the column footing or foundation of the building. In such cases electrode may be further away from the building.

Artificial Treatment of Soil

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes

shall be reduced by addition of sodium chloride, calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

Hardware Items

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes, and in case of copper plate electrodes.

Location of Earth Electrodes

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

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

Installation

Various Types of Electrodes

Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in drawing.

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

Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as shown in drawing.

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

Artificial treatment of soil When artificial treatment of soil is to be resorted to, the electrode shall be surrounded by charcoal/coke and salt and as indicated in enclosed drawings. In such cases, excavation for earth electrode shall be increased as per the dimensions.

Watering arrangement

a) In the case of plate earth electrodes, a watering pipe of 20mm dia. medium class G.I. pipe shall be provided and attached to the electrodes and a funnel with mesh shall be provided on the top of this pipe for watering the earth.

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

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

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

Earthing conductor (Main earthing lead)

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

b) In the case of pipe earth electrode, wire type earthing conductor shall be secured as indicated in drawing using a through bolt, nuts and washers and terminating socket.

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

d) The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by: Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and, Bolt, nut and washer in case of strip conductor.

Earth bus and main earthing terminal

In all installations, main earthing terminal shall be provided at the main switchboard. This may be in the form of earth stud or single earth bar depending on the type of the switchboard.

A ring earth bus shall be provided in the substation building, switch room, and various panels shall be connected to that earth ring.

Following conductors shall be terminated on to the main earthing terminal.

a) Earth connection from electric supply company (where provided)

b) Earthing conductor from electrode.

c) Protective conductors.

d) Equi - potential bonding conductors

Protective (Loop earthing/ earth continuity) conductor

Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/terminal of the upstream switch board by protective conductors.

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

Earth Resistance

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus. Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the Engineer-In-Charge.

Marking

Earth bars / terminals at all switch boards shall be marked permanently, as "E".

Main earthing terminal shall be marked "SAFETY EARTH - DO NOT DISCONNECT".

Measurement of Earth Electrode Resistance

Two auxiliary earth electrodes, besides the test electrode, are placed at suitable distance from the test electrode. A measured current is passed between the electrode ‘A’ to be tested and an auxiliary current electrode ‘C’ and the potential difference between the electrode A’ and auxiliary potential ‘B’ is measured. The resistance of the test electrode ‘a’ is then given by

R = V/I Where,

R - Resistance of the test electrode in ohms

V- Reading of the voltmeter in volts

I - Reading of the ammeter in amps

Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator is used.

If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.

At the time of test, the test electrode shall be separated from the earthing system.

The auxiliary electrodes shall be of 13mm diameter mild steel rod driven up to 1 m into the ground.

All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode C shall be placed at least 30m away from it and the auxiliary potential electrode’ B’ shall be placed mid-way between them.

Unless three consecutive readings of test electrode resistance agree, the test shall be repeated by increasing the distance between electrodes A and C up to 50m, and each time placing the electrode B mid-way between them.

On These principles, " Megger Earth Tester" containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.

Excavation

1) Bore a hole into the earth (minimum diameter 6"). Hole should be bored to allow installed unit to be as close to vertical as possible
2) A 14" hole must be provided for the cover box.
3) Depth of hole must be 6" deeper than the vertical length of the system.
4) Top vent ports must be left open to the atmosphere for continuous air circulation by using the protective test well provided.
5) Plate Type Earthing (Cu/GI), Crow Foot Earthing and Cu Claded rod earthing, the mixing procedure of Backfill will be same as like in the electrolytic Earthing.

Installation

1) Remove sealing tapes from the bottom of unit only. Tapes must be saved and made available to the electrical inspector to verify removal and proper installation. Do NOT remove the green and white "Bury to Here" marker from the top of the unit.
2) Position the unit in the hole. Use green and white "Bury to Here" marker as a guide to depth in which unit shall be buried. Three bags of are included with each 10' electrode.
3) Pour around electrode in augured hole. Do not mound backfill past green and white marker.
4) Place box with cover over the top of the electrode so that the cover is at grade level. Use backfill to stabilize box around the electrode. This keeps the breather holes free of obstruction and debris. Top of box should not contact the top of the electrode.
5) Remove top sealing tape ONLY after backfill is complete. This prevents soil from blocking the vent ports

Connection

1) Connect grounding conductor to ground rod pigtail exothermally.
2) Bury grounding conductor 30inch below grade.

Conventional Lightening Protection System

The lightning protection system shall be based on conventional Lightening protection system and shall be carried out as per IS / IEC – 62305-3 as relevant.

The lightning protection system shall be designed to attract lightning includes current level sometimes in excess of 200 KA and speed approx. 1/3 the speed of light. For lightning protection, Finial Air terminal shall be installed above the highest points of the building which captured lightning & mast should be provided at the appropriate height corresponding to the area to be protective by the lightning rod.

Gel/Chemical earthing can be done with a chemical compound which is capable of absorbing and retaining the moisture for a long time. It reduces the soil resistivity and low earth impedance.

Lightning finial Rods

Air terminals should be designed to attract a lightning strike, thereby becoming the preferred lightning attachment point.

Down-Conductor, Bonding and Shielding

Down conductors should be installed in a safe manner through a known route, outside of the structure. It leads the current of the lightning stroke from the capturing head to the earth electrode.

Surge protection device

This shall also installed as per relevant IEC-62305-3 a required .

Grounding

The grounding system must address low earth impedance as well as low resistance. A spectral study of lightning's typical impulse reveals both a high and low frequency content. The high frequency is associated with an extremely fast rising "front" on the order of 10 microseconds to peak current. The lower frequency component resides in the long, high energy "tail" in the impulse. In lightning protection, low earth impedance at higher frequencies.

A single point grounding system is achieved when all equipment within the structure(s) are connected to a master bus bar which in turn is bonded to the external grounding system at one point only. Earth loops and differential rise times must be avoided. The grounding system should be designed to reduce AC impedance and DC resistance. The shape and dimension of the/earth termination system is more important than a specific value of the earth electrode. Ground rings· around structures are useful. They should be connected to the facility ground. Exothermic (welded) connectors are recommended in all circumstances

Man-made earth additives and backfills are useful in difficult soils circumstances: they should be considered on a case-to-case basis where lowering grounding impedances are difficult and/or expensive by traditional means. Regular physical inspections and testing should be a part of an established preventive maintenance program.

Earthing

Gel/Chemical earthing technology with adequate galvanization filled with a suitable earth enhancing chemical compound, which give low earth impedance. Which also capable of absorbing and retaining the moisture for a long time, it reduces the soil resistivity and helps in faster dissipation of fault current.

Absence of Corrosion

Practically no need to change i.e. fit and forget.
Earthing should be non-corrosive, so there is not much variation in Ohmic value.

The compound should become part of the soil around the electrode.

It should require less space and time to install the earthing electrode.

Bonding

In order to achieve a common earth base at any installation, equipotential bonding of the system is necessary. To achieve this, copper strip of 25mm x 3mm dimension is dug in and around the site in the 45cm deep trench and all earth pits are connected together. The communication earth should be connected with the earth grid through Isolation Spark Gap or directly as per advice of the equipment provider.

5.27. IV PHOTO VOLTAIC ON GRID ROOF TOP SOLAR WORK

General

ON Grid Solar Power Plant Roof Top System

In this system Supply, Install and commission of solar power plant on your roof, produce electricity in the day time and directly convert them into AC power and use for loads during day time or export to Grid. This system is most common for applications above 120Kwp upto MW size.

Solar PV Modules

Solar cells produce direct current electricity from light, which can be used to power equipment or to charge a battery. Cells require protection from the environment and are usually packaged tightly behind a glass sheet. When more power is required than a single cell can deliver, cells are electrically connected together to form photovoltaic modules, or solar panels. A photovoltaic module is a packaged interconnected assembly of photovoltaic cells, which converts sunlight into electrical power. The cells are hermitically sealed between glass and back cover (Tedlar) to protect them from harsh environments.

Module Mounting Structure

The module mounting structure is designed for holding suitable number of modules in series. The frames and leg assemblies of the module mounting structures is of Mild Steel hot dip

galvanized of suitable sections of Angle, Channel, Tubes or any other sections conforming to IS:2062 to meet the design criteria. All hardware considered for fastening modules with this structure are of very good quality of Stainless Steel (SS304). The module mounting structure is designed in such a way that it will occupy minimum space without sacrificing the output from SPV panels at the same time it will withstand severe wind speed up to a maximum 150 kmph.

Junction Boxes

The junction boxes (AJB) are of dust, vermin, and waterproof and made of Thermo Plastic. The terminals will be connected to copper bus-bar arrangement of proper sizes. The junction boxes will have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables.

Solar Inverter

The solar inverter shall supply continuous power to the dedicated load with support to the load coming from the solar array, Grid Power in order of preference. The PV String Inverter has MPPT charge controller which will provide the required output within the range for any variation of solar panel voltage. The DSP control circuit should automatically adjust the DC-DC converter to ensure that it should always match to the PV array under varying conditions and transfers the maximum possible power. The DC output from the MPPT is fed to the high efficiency Inverter and the same is synchronized with the grid and feeds power to the grid thereby exporting the same.

DC Distribution Board (DCDB)

This is made of MS enclosure with suitable powder coating. There is a separate suitable switchgear arrangement in this DB for input from AJB and suitable output with 3 or 6 connections to the string inverter. We draw the connections to the PV inverter through MC4 connectors for firm current flow. This can also be fitted with an energy meter for display and recording the data optionally. vi. AC Distribution Board (ACDB). This is made of MS enclosure with suitable powder coating. One breaker will be provided in ACDB with MCB of suitable capacity to link PV inverter and EB supply side. This is to facilitate disconnection during maintenance. One electronic energy meter of Single/three phase as required is fitted in ACDB to measure the energy exported from the SPV power plant.

Lightning Arrestor

The SPV Power Plant needs be provided with suitable lightening and over voltage protection. The principal aim in this protection is to reduce the over voltage to a tolerable value before it reaches the PV or other sub-systems components. The source of over voltage can be lightening or any other atmospheric disturbance. Each LA will have to be earthed through suitable size earth bus with earth pits.

Earthing

Each array structure of the PV yard needs be grounded properly using adequate number of earthing kits. Each kit will contain super earth mixture and galvanized clamp and SS rod. All metal casing/shielding of the plant will be thoroughly grounded in accordance with Indian Electricity Act/IE rules. Each Resistance should be tested after earthling by calibrated earth tester. The Bidder shall make testing arrangements. The earthing pit shall have to be made as per IS: 3043. All the array structures, equipments & control systems will be connected to the earth.

Cables & Accessories

All cables will be of copper as per ISI and should be of 650V/1.1 KV grade as per requirement. All connections are properly made using suitable connector/lug/terminal crimped with use of suitable proper cable glands. The size & type of cables/wires are chosen considering the line loses, maximum load on line, keeping cable drop within permissible limit and other related factors.

System Design

I	**SPV POWER PLANT**	**(Udalguri & Silchar)**
1 **1**	System Capacity	90kWp
2	Expected Annual Energy Generation-day/Month/Year	135000 units
3	Proposed PV (Photovoltaic) Module Type	Poly or Mono PERC
4	Module rating	450Wp
5	Number of modules	200 Nos
6	PCU /Inverter Rating	90Kwatt-1No.
7	No.of power conditioning unit/ Inverter	1 or 2 No.
8	Electrical parameter for interconnection	415V 3- Phase
II	**Mounting Arrangement**	
	Type of Installation	Roof top / Ground-mount
2	Mounting type	Fixed mounted
3	Surface azimuth angle	180
4	Structure Angle	As per latitude of the place
5	Area required for installation	100 Sq. Ft per kWp

6	Wind resistance	150 km/ hr

Sl No.	DESCRIPTION	SCOPE
1	Detailed Bill of Materials	
2	Project Activity Chart	
3	Supply of Materials as given in Techno Commercial Proposal	
4	Access Ladder to Roof	
5	Place for storing materials during installation with lock and Key	
6	Erection of PV modules on Structures	
7	DC Wiring & Cabling for Module strings, AJB & Inverter	
8	AC Cable from ACDB to LT Panel (Interconnection point)	
9	Erection of Inverters	
10	Erection, Testing & Commissioning of ACDB	
11	Space Provision for ACDB	
12	Laying and Termination of LV cables from ACDB to Distribution Boards	
13	Erection of Earthling for PV array Area	
14	Erection of Earthling from Ground to terese area	
15	Erection of Earthling For Lightening arrestor	
16	Installation of Remote Monitoring system	

Installation & Commissioning

Installation is done by well trained personnel which includes checking the delivered items for transit variations, specifications as per requirement, BOQ. Then the MMS is fitted with necessary anchoring, grouting, concreting also considering the shadow free space, inclination and direction. After the MMS the SPV modules are mounted suitable with horizontal symmetry. Then AJB is suitably fixed to the MMS pole to achieve the least distance of wiring and with no joints. Suitable connectors are used to make the wiring joint free. Then the cables are drawn to the DCDB near the string inverter in a suitable control room near to grid mains distribution where to inverter is to be fixed. Then the inverter is fitted with anchor

bolts and the bracket suitable for wall mounting. Then ACDB is fitted next to the inverter so that both grid and inverter are side by side to the ACDB for ease of connection and lowest distance of wiring.

Warranty/Guarantee

Warrants that the Rooftop Solar PV Power System and the Interconnection Facilities for a period of 18 months from Dispatch and Commissioning as per manufacture defects.

5.28. B.I. INTERNAL ELECTRIFICATION

Conduit and Wiring System

P.V.C Conduit

Scope

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

Standard Applicable

Indian Electricity Act 1910 and Indian Electricity Rules 1956 amended up to date.

Relevant Indian Standard codes of Practice for type of work as per appendix.

Conduits and accessories steel conduits

The Conduits shall be of steel, the wall thickness shall not be less than 1.6 mm (16 SWG) for conduits up to 32 mm dia and not less than 2 mm (14 SWG) for conduits above 32 mm dia. They shall be solid drawn or seamed by welding and finished with galvanised or black stove enamelled surface as specified in Schedule of Works.

Accessories

(i) All conduits accessories shall be threaded type and under no circumstances pin grip type or clamp grip type accessories shall be used.

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

(iii) Minimum 60 mm depth junction boxes shall be used in roof slabs in recessed conduit system and in other places shall be as per IS 2667 - 1977.

(iv) Saddles for surface conduit work on walls shall not be less than 0.55 mm (24 Gauge) for conduits up to 25 mm dia and not less than 0.9 mm (20 Gauge) for larger diameter. The corresponding width shall be 19 mm & 25 mm.

Conduit Joints

(i) The conduit pipes and accessories shall be of suitable material complying with IS:2509 - 1973 and IS:3419 - 1976 for rigid conduits. The interior of the conduits shall be free from obstruction. The make shall be as specified.

(ii) The conduits shall be circular in cross section. The conduits sizes are designated by their nominal outside diameter. The dimensional details shall be as follows:

SL.No.	Nominal Outside Diameter	Maximum Outside Diameter	Minimum Inside Diameter	Maximum Permissible Eccentricity	Maximum Permissible
1	20	20 + 0.3	17.2	0.2	0.5
2	25	25 + 0.3	21.6	0.2	0.5
3	32	32 + 0.3	28.2	0.2	0.5
4	40	40 + 0.3	35.8	0.2	0.5
5	50	50 + 0.3	75	0.5	0.8

Note: All Dimensions are in MM

Protection against Condensation

The Conduit pipes shall be fixed by means of staples, hooks or means of saddles not more than 60 cm apart or by any other approved means of fixing.

All threaded points of conduit pipes shall be treated with some approved preservative compound to ensure protection against rust.

Protection of Conduit against Rust

a. Conduit work of each circuit section shall be completed before cables are drawn.

b. Conduit Pipes shall be joined by sleeved coupler and sleeved accessories only and threads on conduit pipes in all cases shall be 15 mm long, sufficient to accommodate full threaded portion of coupler and accessories in case of conduits. In case of rigid PVC Conduit, all points shall be sealed / cemented with an approved cement.

Cut ends of conduit pipes shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductors while pulling than through the pipes.

Bends In Conduit:

All necessary bends in the system including diversion shall be done by either neatly bending the pipes without cracking with a bending pipe of not less than 7.5 cm. In respect of rigid PVC Pipes the bending shall be achieved with approved method of heating. Alternatively the bends may be formed by using suitable accessories such as bends, elbows and Junction Boxes

(cast iron / MS in case of rigid steel conduits and PVC in case of rigid PVC Conduits).

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

Painting of Conduit and Accessories

a. Conduit work of each circuit section shall be completed before cables are drawn.

b. Conduit Pipes shall be joined by sleeved coupler and sleeved accessories only and threads on conduit pipes in all cases shall be 15 mm long, sufficient to accommodate full threaded portion of coupler and accessories in case of conduits. In case of rigid PVC Conduit, all points shall be sealed / cemented with an approved cement.

Cut ends of conduit pipes shall have no sharp edges nor to avoid damage to the insulation of conductors while pulling than through the pipes.

Sizing of Conduits:

(i) Conduit size shall be so selected that the maximum number of PVC Insulated cables including earth conductor that are drawn in one conduit shall not exceed the numbers shown in the table below : Maximum number of PVC insulated 650V/1100VGrade Aluminium/Copper Conductor Cable as per IS: 694 - 1990.

Nominal Cross-sectional Area of conductor in Sq. mm	**20mm**		**25mm**		**32mm**		**38mm**		**51mm**		**64mm**	
	S	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-		3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5

Nominal Cross-sectional Area of conductor in Sq. mm	20mm		25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B	S	B
70	-	-	-	-	-	-	-	-	4	3	5	4

Note:

(i) Column headed 'S' apply to runs of conduits which have distance not exceeding 4.25 mm between draw in boxes and which do not deflect from straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

(ii) The minimum size of conduit shall be 20 mm for lighting and 25 mm for power wiring.

Fixing of conduits

Surface Conduit

a. Conduit Pipes shall be fixed by saddles, with sleeves in an approved manner at an interval of not more than one meter, in respect of rigid steel conduit and 60 cm in respect of rigid PVC Conduit but on either side of coupler or bends or similar fittings. Saddles shall be fixed at a distance of 30 cm from the center of such fittings.

b. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided.

c. In respect of rigid PVC Conduits, if the pipes are susceptible to mechanical damage, they shall be adequately protected.

Recess / Concealed Conduit

All necessary bends in the system including diversion shall be done by either neatly bending the pipes without cracking with a bending pipe of not less than 7.5 cm. In respect of rigid PVC Pipes the bending shall be achieved with approved method of heating. Alternatively the bends may be formed by using suitable accessories such as bends, elbows and Junction Boxes (cast iron / MS in case of rigid steel conduits and PVC in case of rigid PVC Conduits). No length of conduit shall have more than equivalent of four quarter bends from outlet to outlet

Outlet Boxes

Switch/outlet boxes shall be made of metal on all sides except on the front. Boxes shall be G.I. Up to 10cmx20cm size Box shall have wall thickness of 18 SWG and

above 10cmx20cm shall have 16 SWG. The metallic boxes shall be painted with anti corrosive paint before erection. Clear depth of the box shall not be less than 50mm all fitting shall be fitted in flush pattern. Switch/outlet boxes shall be suitable to house modular type light

Fan Box

Fan Box shall be made out of 14 gauge M.S. sheet in hexagonal shape. The dia of box shall be 150 mm and depth of box shall be 80 mm. A M.S. covers plate size 160 mm x 160mm x 16 gauges to be provided in the back of fan box. 12 mm dia M.S.Rod to be provided for fan hanging arrangement in the box. A 28 mm dia knockout To be made in all six hexagonal vertical part for conduit entry in the box. The box shall be painted with 2 coat of primer. A 180 mm dia, 2 mm thick hylem sheet Cover to be provided. (The sample to be approved before procurement / execution by Engineer-In-Charge / consultant).

5.29. B. II DISTRIBUTION BOARDS

General

a) Distribution Board shall be double door type with extended loose wire box & M.S. Junction Box at the top and suitable for flush installation. All distribution boards shall be of three phases (415 Volts) or single phase (240 Volts) type with incoming isolator or MCB and/or RCCB as in Bill of Quantities. Distribution boards shall contain plug in type miniature circuit breaker mounted on bus bars. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS 8828-1978 & IS 8828 - 1996. Bus bars shall be of electrolytic copper. Neutral bus bars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Separate neutral & earth bus bar link to be provided for each phase. Phase barrier shall be fitted and all live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have an etched zinc base stove painted followed by synthetic stove enamel, colour light gray. A circuit identification card in clear plastic cover shall be provided for each distribution board. IK (Mechanical Stress) rating of distribution board enclosure shall not be less than IK –07/ 08 / 09.

b) Distribution Board with single phase outgoings requirement shall be Horizontal type. Distribution Board with three phase outgoings requirement shall be Vertical/ Horizontal type. Distribution Board installed in indoor dry locations shall conform to IP-42. Distribution Board installed in outdoor & wet locations shall conform to IP- 65.

c) Miniature Circuit Breakers for lighting circuits shall be of "B" series where as the circuits feeding discharge lamps (HPMV or HPSV) halogen lamps, all power outlet points, equipment/ machinery shall be of "C/D" series (Motor circuit) types. All miniature circuit breakers shall be of not less than 10KA rated rupturing capacity. All miniature circuit breaker terminals shall have safety shutter.

d) Distribution board shall be provided with isolator or MCB and/or earth leakage circuit breaker. Earth leakage circuit breaker shall be current operated type and of 30mA sensitivity unless otherwise stated. RCCB shall be mounted within distribution board box for single phase distribution board while in three phase distribution board RCCB shall be either mounted within distribution board box or in a separate MS box below distribution board. Width and depth of RCCB box shall be same as that of distribution board box and of same finish. Height of RCCB box shall be sufficient to accommodate RCCB & termination of incoming & outgoing wires. Distribution board box ,isolator, MCB'S used shall be of one/same manufacturer. Standard size manufactured by approved manufacturer shall be used. In case size required is not standard size of manufacturer, in that case next standard size distribution board box shall be used with incoming & outgoing MCB. Additional cutout/space for outgoing MCB shall be plugged with blank plates. No extra cost shall be paid for using bigger/higher size distribution board box and blank plates. (The sample to be approved before procurement / execution by Engineer-In-Charge / consultant).

Sub Distribution Panel (TTA)

General

Sub Distribution Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

Standards

The equipment shall be designed to conform to the requirements of:

IS 8623 – Factory Built Assemblies of switchgear and control gear.

IS 4237 – General requirements for switchgear and control gear for voltages not exceeding 1000V.

IS 2147 – Degrees of protection provided by enclosures for low voltage switchgear and control gear.

IS 375 – Marking and arrangement of bus bars.

Individual equipment housed in the sub distribution boards shall conform to the following IS specifications:

a) Moulded Case Circuit Breakers - IS: 13947-2/IEC 947-2

b)	Miniature Circuit Breaker	-	IEC - 60898
c)	Contractors	-	IEC – 947-4-1, IS13947-4-1
d)	Current Transformers	-	IS: 2705
e)	Indicating Instruments (Analogue)	-	IS: 1248,
f)	Indicating Instruments (Digital)	-	IS: 13875
g)	Integrating Instruments (Analogue)	-	IS: 722, IS: 13779-1999
h)	Integrating Instruments (Digital)	-	IS: 13779- 1999, IS: 14697
i)	HRC fuse links	-	IS: 13703 / IEC 269

Submittals

The Contractor shall furnish relevant descriptive and illustrative literature on switchgears and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams and control wiring.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) All drawings and data shall be in English.

Constructions

Sub Distribution boards shall be metal enclosed, indoor, floor mounted free standing and/or wall mounted type made up of the required vertical section, which when coupled together shall form continuous dead front. Sub distribution boards shall be dust and damp protected, the degree of protection being no less than IP: 54 to IS:2147. Sub distribution boards shall be fabricated with a framed structure with rolled/folded sheet steel channel section of Sheet steel shroud and partitions shall be of minimum 2mm thickness, doors and covers shall also be of 2mm thickness. All panel doors shall be pad lockable type. All sheet steel work forming the exterior of sub distribution boards shall be smoothly finished, leveled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust proof including neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearance to be maintained after taking into account connecting bolts, clamps etc.

i) Between Phases - 32mm

ii) Between Phases and neutral - 26mm

iii) Between Phases and earth - 26mm

iv) Between Neutral & earth - 26mm

All insulating, materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. SMC (Sheet Moulded Compound) supports & shrouds shall be used.

Functional units such as moulded case circuit breakers shall be arranged in multi-tier formation. The design of the sub distribution boards shall be such that each MCCB unit shall be fully compartmentalized.

Insulated barriers shall be provided with vertical section and between adjacent section to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fastness to prevent unauthorized access. Sub distribution boards shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables.

For each cable alley, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3 mm thick.

A base frame made out of 75mm x 40mm x 5.0mm M.S. Channel to be provided.

Metal Treatment and Finish

All metal work used in the construction of the sub distribution boards should have under gone a rigorous metal treatment process as follows:

a) Effective cleaning by hot non alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution

b) Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any followed by cold water rinsing to remove traces of acidic solution.

c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

d) Passivating in de-oxalite solution to retain and augment the effects of phosphating.

e) Drying with compressed air in a dust free atmosphere.

f) A finishing coat of powder coating of Siemens grey colour and thickness of powder coating shall not be less than 90 micron.

Bus Bars

The bus bars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade E-91E.

The bus bars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity shall be as per actual calculation.

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creep age distance shall be provided on the bus bar system to minimize the possibility of fault. The main phase bus bars shall have continues current rating throughout the length of the panel. The cross section of neutral bus bars shall be same as that of the phase bus bar for bus bars of capacity up to 250 Amp; for higher capacities, the neutral bus bar shall not be less than half (50%) the cross section of that of the phase bus bars. Connections from the main bus bars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars shall be colour coded with PVC heat shrinkable sleeves.

The sub distribution boards shall be designed that the cables are not directly terminated on the terminals of MCCB etc. but are terminated on cable termination links. Capacity of aluminium bus bars shall be considered as 1.0 Amp per sq. mm of cross section area of the bus bars.

Moulded case Circuit Breaker

General

Moulded Case Circuit Breakers shall be incorporated in sub distribution boards wherever specified. MCCB's shall conform to IS 13947-2 and / or IEC 947-2 in all respects. MCCB's shall be suitable either for single phase AC 230 volts or three phase 415 volts.

Frame Sizes

The MCCB's shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i)	Up to 100A rating	…….	100Amp frame.
ii)	Above 100A to 200A	…….	200Amp frame.
iii)	Above 200A to 250A	…….	250Amp frame.
iv)	Above 250A to 400A	…….	400Amp frame.
v)	Above 400A to 630A	…….	630Amp frame.

Constructions

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire extinguishing device shall be provided for each contact. Tripping unit shall be of thermo magnetic type up to 250 A for adjustable overload & short circuit protection and shall

be microprocessor type above 250 A for adjustable overload, short circuit & earth fault protection. MCCB shall be line load reversible type. Device shall have IDMT characteristics for sustained overload, and short circuits. MCCB shall be current limiting type.

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

Rupturing Capacity

The Moulded Case Circuit Breaker service breaking capacity (Ics) shall be based on actual calculation.

Testing

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished. Pre-commissioning tests on the sub distribution boards incorporating the MCCB shall be done as per standard.

Measuring Instruments for Metering

General

Direct reading electrical instruments shall be in conforming to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

Digital Ammeters

Digital Ammeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

Digital Voltmeters

Digital Voltmeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

MFM Meter

Digital MFM shall be confirmed to ISO:62053. Multi-Function Meter used in electrical panels. These meters are designed to measure various electrical parameters such as voltage, current, power (active, reactive, apparent), energy consumption, power factor, and frequency. They are commonly used in industrial, commercial, and sometimes residential settings to monitor and manage electrical usage, ensuring efficient operation and sometimes for billing purposes in larger installations.

Current Transformers

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 15A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

Measuring : Class 1.0

Protection : Class 5 P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Control switches

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

Cable Terminations

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

Control Wiring

All control wirings shall be carried out with 1100V grade single core ZHFR cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

Terminal Block

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

Labels

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

Testing at Manufacturing Work

All routine tests specified is IS:8623-1977 shall be carried out and test certificates submitted to the Engineer – in –Charge.

Testing and Commissioning

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check

c) Insulation test: When measured with 500 V meggar, the insulation resistance shall not be less than 100 mega ohms.

d) Trip tests & protection gear test.

5.30. AUTOMATIC TRANSFER SWITCH

General requirements

The following covers the Automatic Transfer Switch Equipment (ATSE) and its By-Pass equipment.

The ATSE shall be composed of

- Two separate Load Break Switches,
- A mechanism to operate and mechanically interlock the switches,
- An actuator made of a motorized unit or a double solenoid mechanism (both momentarily energized)
- A 3 phases monitoring device and control module (MDCM) for monitoring supply circuits and for transferring the load circuit from one supply to another.

The ATSE shall be fully integrated in one device. No additional wiring other than the power connection shall be allowed to facilitate the proper functioning of the ATSE with the MDCM.

All the elements of the transfer switch equipment and control module shall be of the same manufacturer.

The ATSE shall be of the PC type.

The ATSE shall have 3 stables positions: Normal, Isolated and Emergency.

The ATSE shall be of a Dis connector type with fully visualized breaking.

The ATSE shall be able to do On Load Manual switching.

The ATSE must be proposed in 3 and 4 poles versions.

GAD requirements

1. The transfer switch unit shall be electrically operated and mechanically held.
2. It shall be no power consumption while in a stable position other than the one required for the control unit.
3. The electrical actuator shall be a motorized unit or a double solenoid mechanism, which is momentarily energized.
4. The switches shall be inherently mechanically interlocked to ensure at any moment only one out of the three stable positions.
5. The system shall incorporate a position indicator for the 3 stable positions.
6. To prevent source overlapping the transfer is operated through distinct isolated positions. The sensing and logic shall be built-in microprocessor for maximum

reliability and with option of serial communications feature. To facilitate flexibility of installation there shall be provision of Line/ Load reversibility.

7. The switching contact shall be silver plated and maintenance free in various environments. It shall be of self cleaning capability to optimize the quality of the contact during operation
8. The Neutral pole of ATS shall be fully rated (100% rating as that of all 4 poles).
9. The 4 poles shall switch simultaneously.

Standards & Codes

The ATSE shall conform to the requirements of the IEC Standard 60947-6-1 for the source transfer function and 60947–3 for Disconnection and manual on load switching.

The MDCM shall comply with the following standards:.

Emission General standard

- EN 55022 Conductor Emission
- EN 55022 Radiated Emission

Immunity General standard

- EN 61000-4-2 Electrostatic Discharge (ESD)
- EN 61000-4-3 Radiated electromagnetic field
- EN 61000-4-4 Electrical fast transient (EFT)
- EN 61000-4-5 Surges
- EN 61000-4-6 Conducted radio frequency field
- EN 61000-4-8 Power frequency magnetic field
- EN 61000-4-11 Voltage dips, short interruptions and variations
- EN 61000-4-13 Harmonics and inter harmonics
- IEC 61010-1 Electromagnetic compatibility

Safety requirements & features

The ATS shall be of Dis connector type as per IEC 947-3

It shall not be possible to mix the two supplies (Normal supply and Emergency supply) in case of any failure of the equipment. This characteristic must be guaranteed by a proper design of the mechanism.

Opening and Closing operations of the contacts must be independent from the driving mechanism. The speed of the contacts shall be independent of the speed of motor or manual operation to ensure the safety of the operator.

In case of contacts welding, the ATSE must remain in its actual position, in Manual or Automatic operation, according to IEC 60947-3. Neither the manual nor the automatic operation can lead to a failure of the mechanism or of the interlocking. The mechanical indicator shall show the actual position in contact welded situation.

The ATSE shall have a Manual and Automatic mode: the swap between both modes shall be possible only with a key or selector on the front face. Manual operation shall be prohibited in automatic and Automatic operation shall be inhibited in Manual mode.

The ATSE shall have a built-in provision for padlocking in the Isolation position for the safety of the operators. A provision for a padlocking in Normal or Emergency positions shall also be provided.

Automatic commands shall be inhibited when the product is padlocked

The padlocking shall be possible only in Manual position.

The ATSE shall be able to accommodate up to three padlocks at the same time.

A handle for manual operation shall be provided for emergency transfer purposes.

The handle shall be located on the ATSE itself to ensure a safe and quick operation during power outages. The handle shall be easily removable for automatic operation.

Manual transfer shall be possible on load, without any upstream disconnection, with respect to the safety of the operator. This feature is essential in case of emergency and panic.

It shall be possible to block the re-transfer process via programming. When selected, re transferring to the Main source must be validated locally or remotely via keypad or external contact.

The replacement of the motor operated actuator shall be possible under live condition with respect to the operator safety (isolation distances, easy access to the fixing elements).

Operations

The ATSE shall be supplied by any present source. It shall allow the ATSE to be controlled in the 3 positions with only one source present.

The ATSE shall have high short time current withstand capability (I_{cw} 1 second in accordance to IEC 60947-3).

Manual re transfer function can be inhibited and must be possible either locally or from remote.

The ATSE shall have the possibility to be electrically controlled in any of the 3 positions by mean of dry contacts. It overrides the automatic sequence. Once back in Auto mode, the ATSE shall come back to the proper position.

Automatic operation via the MDCM

The monitoring device and control module (MDCM) must be integrated within the ATSE. Electrical Control of the product position must be possible and controlled locally or remotely. Any automatic command must be inhibited during control operation (takeover).

Parameters sensing & setting

The MDCM shall include 3 phases sensing for monitoring of voltage and frequency to detect the presence and loss of the power supply for activation of the automatic transfer. The settings are as following.

PARAMETER	SOURCES	THRESHOLD	HYSTERISIS
Under voltage	Mains and Backup, 3 phases	80 to 98%	81 to 99%
Over voltage	Mains and Backup, 3 phases	102 to 120%	101 to 119%
Under frequency	Mains and Backup	80 to 99%	80.5 t0 99.5%
Over frequency	Mains and Backup	101 to 120 %	100.5 to 119.5%

Voltage settings shall be field adjustable in 1% increments either locally with the display and keypad, or remotely through serial communication. Frequency settings shall be adjustable in 0.1% increments either locally with the display and keypad, or remotely through serial communication. All settings shall be adjustable directly from the front face, opening of the MDCM is strictly forbidden for obvious reasons of safety and possible damages. The MDCM shall have a phase sequence detection to ensure the proper voltage vectors sequence on both power supplies. The MDCM shall have programming for selection of network type 4NBL/41NBL/42NBL/3NBL/2NBL/2BL/1BL and capability to monitor the minimum and maximum voltages and frequencies threshold and hysteresis. The MDCM shall allow the setting of the sources priority. The MDCM shall be equipped with the activation of manual re-transfer mode. The MDCM must be equipped with a permutation counter to enable to record the life span of the ATSE represented by the number of transfer operations. Resetting of this counter shall be conditioned by 4 digits numerical password with 2 levels of security. Interface with the MDCM The MDCM must be easily configurable via a HMI dialogue interface complete with a 2 levels security 4 digits numerical Password for programming access right. The MDCM shall be equipped with local visualization of three phase currents, powers (P, Q, S), frequency and power factor through 3 current transformers measurement from the 2 sources. Source status shall be clearly visible on the front of the unit for both normal & emergency, stated in a clear schematics diagram. The controller shall provide digital readout of voltage on all 3 phases, frequency and phase rotation. Inputs/outputs, communication.

The MDCM shall be able to provide up to four Inputs (Programmable NO or NC) and four Outputs (NO Type) for interfacing with control system. The inputs and outputs functions shall be versatile (no unique function), the assignment being done by the HMI or the communication. The MDCM can be equipped with an option to enable communication via RS485 module MODBUS protocol with a transmission speed up to 38400 bps. The link shall be capable of reading the voltages, timers and inputs values, setting all parameters values and inputs/outputs functions.

Timers settings

An adjustable timer of 0 to 60 seconds shall be provided to detect the priority network failure, to override any transient outages of the normal supply. (Main Failure Timer, MFT). A timer of 0 to 60 seconds shall be provided to validate the stability of emergency network before transfer, once the Generator Set supply is available. (Delay To Transfer, DTT). While

transferring to emergency, a possibility to stay in position 0 shall be provided from 0 to 20 seconds (O Main Failure timer, 0MF). An adjustable timer of 0 to 30 minutes shall be provided to detect priority network return to normal, to override any false availability of the normal supply. (Main Return Timer, MRT). While transferring back to primary source, a possibility to stay in position 0 shall be provided from 0 to 20 seconds (O Main Return timer, 0MR). An adjustable timer of 0 to 30 minutes shall be provided to allow the generator cooling down after load retransfer from standby source to Mains source (Cool Down Timer, CDT). The controller shall provide the ability to prevent retransfer to Mains from happening, except if the user validates manually the retransfer. (Manual Re-Transfer).

Maintenance & testing

The MDCM shall provide the possibility to run a test ON load and OFF load.

It shall be possible to actuate these sequences from the front face HMI or via the Modbus link.

Maintenance of the electrical parts (Controller or Motorization unit) shall be possible without disconnection of the power conductors.

It shall be possible to change any actuator unit based on a motor technology in less than 10 minutes without disconnection of the power conductors. During this operation, it shall still be possible to operate manually the switch with the MDCM and motorization removed.

Both Local and Remote control of test sequences shall be possible on the Switch.

Inspection at factory

The inspection / testing of all the ATS / STS shall be done at manufacturer works before dispatch by Engineer incharge/PMC& consultant.

Factory testing and certification

The complete ATSE shall be factory tested to ensure proper operation of the individual components together and correct overall sequence of operations. The test must also ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

The manufacturer shall be certified ISO 9001 : 2003 International Quality Standard and the manufacturer shall have third party certification verifying its quality assurance in design / development, production, installation and servicing in accordance with ISO 9001.

Training

The manufacturer / supplier shall ensure the training for Operating staff in the local national language, by means of fully configured Training kits to impart hands-on training to simulate various parameters and for trouble shooting exercise.

5.31. SANDWICH BUS DUCT & RISING MAIN

Scope :

These specifications are intended for design, manufacturing & testing of 3 Phase 3 Wire / 3 Phase 4 Wire / 3 Phase 4 Wire (50%N) / 3 Phase 5 Wire with or without internal earth Sandwich type Aluminium Busbar Trunking System

System details :

The Busbar Trunking System shall be suitable for operational Voltage of 415V / 690V / 1000V with supply frequency of 50Hz / 60Hz, minimum insulation voltage of 1000V & impulse withstand voltage of 8kV & 12kV.

Standards :

- The Busbar Trunking System shall be designed to comply in accordance with the following international standards,
- IEC 61439 – Part 1 : Low voltage switchgear & controlgear assembly- General rules
- IEC 61439 – Part 6 : Busbar Trunking Systems (busways)
- IEC 60529 : Degree of protection
- IS 8623 – Part 2 : Specification for Low Voltage Switchgear & Controlgear Assemblies
- IS 1893 – Part 1 : Criteria for Earthquake Resistant Design of Structures
- IEEE 693:2005 : High Seismic Qualification Level
- Wherever required and specified, the Busbar Trunking System shall conform to Fire Rating of 1000 deg C for 3 Hours.
- Busbar Trunking System should also have Seismic Zone-5, Resistance to Flame Propagation and Fire resistance in building penetrations certification.

Manufacturer :

The manufacturer must have an established track record in design and manufacture of sandwich busbar trunking system, and must have supplied busbar trunking systems for at least 15 years.

The manufacturer must have ISO 9001:2015 certification.

Design & Construction requirements :

General :

The Busbar Trunking System shall be of sandwich construction, non-ventilated and natural cooled design.

Busbars :

- The busbars should be made of high conductivity electrical grade Aluminum (>60% IACS)

- Purity of Aluminum conductor should not be less than 99.6%
- Aluminum busbars should be Tin plated at the joint area to avoid oxidation
- Where an earth conductor is required, it shall be possible to provide internal earth conductor of the same high conductivity material as the phase conductors and at least of 50% cross section of the phase conductor. Provision for mounting external earth strip to be provided on both side of busduct if required.
- It should be possible to provide a 200% Neutral where specified in BOQ.

Insulation :

- Each bus bar shall be individually insulated by means of Class-F Insulation, if it is multilayer insulation and each layer must have temperature withstand capacity of 155 deg C (Class-F) as well as breakdown voltage of minimum 6kV/layer.
- PET insulation is used for wrapping busbars completely even on conductor edges.
- The insulation should be UL certified.
- Insulation must be Halogen free & RoHS compliance.

Housing :

- The housing shall be made with 1.6mm thick electro-galvanized sheet steel of superior grade with RAL 7015 Epoxy powder coating form both sides (internal & external) to withstand stringent site conditions; e.g. Humid, Costal, Acidic, etc.
- Enclosure must be dust & vermin proof and Provision for mounting external earth strip should be available on Busduct.
- IP rating of indoor busduct must be IP-54 / IP-55 & Outdoor busduct should be IP-66 plus canopy should be provided for protection of Busduct from direct sunlight & heavy rains.

Joints :

- The joint design shall have inbuilt provision of absorbing expansion & contraction of 12mm per joint during operation.
- The joint insulation must be of single piece molded design of thermoset material for longer life and higher temperature withstand & better insulation property.
- The joint construction must allow +/- 3mm adjustment at the time of installation, for ease of adjusting to site measurement variations.
- Stopper arrangement must be provided at every joint to prevent excessive insertion of conductors while jointing.
- The joint bolt must be insulated with a insulation tube. The insulation tube must be of molded one piece.

- The joint design shall have inbuilt provision to prevent excessive insertion of busduct which can damage the insulation tube.
- The busbar ends shall not have holes or slots at the joints to avoid reduction in cross section area which will lead to temperature increase. The electrical continuity shall be through shorting plates, achieving a high contact area of joint cross section and expansion capability.
- It shall be possible to install and remove the joints without disturbing the adjacent feeder section.
- Joint block should have insulators with temperature withstand capacity of class-F.

Plug-in Unit / Tap off units :

- Plug-in Units must be type tested design from NABL accredited laboratory for tests like, Thermal cycling test, Temperature rise test, Short time withstand voltage, Mechanical operations, Impulse withstand voltage, Clearance & Creepage, Mechanical impact and ingress protection test
- Plug-in unit must achieve IP-54 protection & IK10 mechanical impact
- Plug-in Units must have interlocks with Busduct, door and MCCB for human safety
- Plug-in Units shall be suitable for use with MCCB, MCB as well as Switch Disconnector Fuse (SDF)

  Busduct interlock –

  a) Plug-in Box can't be removed from Busduct when MCCB in ON

  b) MCCB can’t be switched ON even when Plug-in Box is mounted on Busduct; it is possible only if interlock plate is engaged with feeder

  Door interlock – a) Door can’t be opened when MCCB is ON

  b) MCCB can’t be switched ON until door is completely closed

  c) Door defeat feature should be available to use in case of emergency
- The design of plug-in units shall be such that, the Earth conductor shall be of ‘First-Make’ ‘Last-Break’ type.
- It should be possible to mount Plug-in Unit even when Busduct is in live condition but while insertion MCCB must be in OFF condition
- The Plug-in unit will be suitable for accommodating MCCBs, MCBs, Meters or other accessories, as required. The Plug-in unit should allow the flexibility of accommodating different reputed MCCB makes, to be mutually agreed depending on the tender requirements.
- Plug-in Unit must be operated using side handle without MCCB ROM, and provision of Padlocking must be provided for human safety

- Plug-in Unit must have Lifting provision for ease of handling and Guide pin for ease of installation
- LED indicator must be provided on Plug-in Unit door which will glow once MCCB is switched ON
- Plug-in units should be plug-in type up to 400A (upto 630A with MCCB ROM) & Bolt-on Type upto 1250A
- It should be possible to offer Bolt-on Type Tap-off Box upto 1250A to withstand vibration due to crane movement, heavy machines in industries

Testing :

- The busduct shall be type tested at a reputed test laboratory (certified by ASTA or ERDA) for the tests as per IEC-61439 Part-1 (Low voltage switchgear & controlgear assembly- General rules) & Part 6 (Bus bar trunking systems & bus ways)
- Short circuit testing of busduct should be for duration of 1 Sec. Neutral & Earth conductor should also be tested for 60% short circuit rating of phase conductor
- Degree of ingress protection (IP rating) shall also be tested at any reputed independent laboratory as per IEC-60529
- Busduct tested for maximum severe Seismic condition of Zone-5 as per IS 1893-2002 and High Seismic Qualification Level as per IEEE 693-2005. Seismic testing done in severe most combinatio and orientation (Horizontal + Vertical installation along with Plug-in box in live condition)

5.32. III LIGHT FIXTURES & FANS

General

All light & power accessories shall be of modular range of plate switch type and shall be of one manufacturer (brand) and type.

Light Switches Modular Type

All switches for control of light shall be of 6/10 Amp unless otherwise stated. All switches shall be modular range of plate switch type. The switches shall be rocker mechanism type with silver contract. All switches shall be of white finish or as sample approved by Engineer-In-Charge/consultant.

6/16 Amp Switch Socket Outlet Modular Type

Switch socket outlet shall be of 3 pin 6Amp outlet shall have safety shutters. The switch shall be of rocker mechanism type with silver contact. Socket outlet shall be shutter type and of modular range of plate type and having white finish or as approved by Engineer-In-Charge / consultant.

Wiring

All FRLS insulated copper conductor multi-stranded wires shall conform to relevant IS codes. Cable conductor size and material shall be as required.

All internal wiring shall be carried out with FRLS insulated wires of 1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switch board may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switch boards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red or yellow or blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FRLS insulated wire for RYB phase wire respectively and black colour FRLS insulated wire for the neutral wires. FRLS insulated green colour wire shall be used as earth continuity conductor and shall be drawn along with other wires.No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications.

All the wire & cables shall be copper up to 16 sq.mm and above 16 sq.mm shall be aluminum except UPS cables. For UPS Incoming & outgoing, only copper cable/ wire shall be used.

Nominal Cross-sectional Area of conductor in Sq. mm	**20mm**		**25mm**		**32mm**		**38mm**		**51mm**		**64mm**	
	S	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**	**S**	**B**
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7

Nominal Cross-sectional Area of conductor in Sq. mm	20mm		25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B	S	B
35	-	-	-	-	-		3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Joints

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

Sub Mains

Sub-main wiring shall be carried out with FRLS Insulated Copper multi-standed wires/cables.

Sub-main cable where called for shall be of the rated capacity and approved make. Every sub-main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the sub-main cables. Cost of junction box/drawn box is deemed to be included in the rates of sub-main wiring. An independent FRLS insulated copper earth wire of proper rating shall be provided for every sub-main. Single phase sub-main shall have single earth wire whereas three phase sub-main shall be provided with two earth wire.

Where sub-mains cables are connected to the switch-gear, sufficient extra lengths of sub-main and mains cable shall be provided to facilitate easy connections and maintenance. For termination of cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed.

Load Balancing

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

Light Fixture & Fan Technical Specification: (Normal Light)

- **IP20 Recessed 10W LED** Downlighter made of pressure die cast aluminum housing, Fixture should have minimum efficacy at System level (Not Chip Level) >=110 lumens/watt with Minimum system Lumens 1000 with maximum system wattage of 9W. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen

maintenance, CCT of 300K/4000K/5700K/6500K (SDCM<5), CRI >80, PF >0.95, working temp range - 0°C < Ta < 45°C, and operating Voltage Range of 240 VAC. It should has a Minimum Internal Surge Protection of 2.5KV. Electronic Switchable ballast. The fixture design should comply with EMC / EMI compliance along with BIS certification for LED Driver & Luminaire.Luminaire manufacture shall provide LM 79 report from NABL accredited lab & LM80 report issued by LED manufacturer.

IP20 Recessed 10W LED Lighter

- **Integral Mirror light LED 2 ft** luminaire made of CRCA housing and PC diffuser (Diffuser-Non yellowing type). The luminaire should have a LEDs with colour consistency SDCM ≤ 5, CRI ≥ 80 and CCT of 3000K/400K/5700K/6500K. Luminaire shall be designed to emit at least minimum 2000 system lumens at a system efficacy of at-least 120 lumen/watt. Power consumption should not be more than 12W (±5%). The Life of fixture (Including Driver):50000 burning Hrs. @ L70B50 Lumen maintenance @ design ambient temp 45 deg C. The electronic driver used shall have a power factor ≥0.95 and THD ≤10%, suitable for an operating voltage range of 140-270V AC, Current Ripple ≤5%, Internal surge protection should be minimum 4KV, electrical insulation class should be Class I & driver should be of Class B serviceability. The luminaire shall be IP20 & IK02 compliant. The minimum dimensions (±5mm) of the batten shall be 44mm(±5mm) X 51mm (±5mm)X 585mm(±5mm). Luminaire manufacturer must have NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" before dispatch as per IS 10322.

Integral Mirror light LED 2 ft luminaire Lighter

- **18W to 22W LED downlight r**ecess IP20 Downlighter made of pressure die cast aluminum housing, Fixture should have minimum efficacy at System level (Not Chip Level) >=110 lumens/watt with Minimum system Lumens 1500 with maximum system wattage of 13.5W. Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 3000K/4000K/5700K/6500K (SDCM<5), CRI >80, PF >0.95, working temp range - 0°C < Ta < 45°C, and operating Voltage Range

of 240 VAC. It should has a Minimum Internal Surge Protection of 2.5KV. Electronic Switchable ballast. The fixture design should comply with EMC / EMI compliance along with BIS certification for LED Driver & Luminaire.Luminaire manufacture shall provide LM79report from NABL accredited lab & LM80 report issued by LED manufacturer.

18W to 22W LED downlight recess Lighter

- **Surface mounted Linear Batten 40W 4ft** luminaire of CRCA housing and PC diffuser (Diffuser-Non yellowing type). The luminaire should have a color consistency SDCM ≤ 5, CRI ≥ 80 and CCT of 3000K/4000K/5700K/6500K.The luminaire shall be compliant with IP20 classification. Luminaire shall be designed to emit at least 4000 nominal lumens at a system efficacy of minimum 120 lumen/watt. Power consumption should not be more than 36W. The lumianire shall have CRI≥80. The Life of fixture (Including Driver):50000 burning Hrs. @ L70B50 Lumen maintenance @ design ambient temp 45 deg C. The electronic driver used shall have a power factor ≥0.95 @ full load and THD ≤10% @ full load and suitable for an operationg voltage range of 140-270V AC. Ripple ≤5% and surge protection should be minimum 4KV, electrical insulation class should be Class I & driver should be of Class B serviceability. Driver should have high & low voltage cut off with auto restart @140-270V. The LED driver should comply to IEC61000-3-2 ed.3.2, 2009 for Harmonics, IEC61347 -2 -13, 2006 in Conjunction with IEC61347-1 ed.2.0, 2007 for Electrical Safety, CISPR 15/ EN 55015 (9 KHz to 30MHz) for RFI, EMI/EMC, IEC 62384 for driver performance test. The luminare driver shall be of the same make/manufacturer/brand as that of LED luminaires. The luminaire driver shall have efficiency of ≥85%.

Surface mounted Linear Batten 40W 4ft luminaire Lighter

- **36W to 40W 2X2 LED flat panel** for surface mounting which provides soft-light and glare free symmetrical illumination. CRCA powder coated white after phosphochromate treatment and High transmittance polystyrene opal diffuser. High efficiency long life LED package in integral module with system lumen efficacy of >110 lm/W and viewing angle of 120° to ensure better uniformity.Powered by built-in Isolated, SELV Output electronic LED driver (SMPS based constant current

supply) with Output Short-circuit protection, Surge protection & other reliability test. CRI >80, Color temperature 3000K/4000K/5700K/6500K, THD <20% and PF >0.95,IP20, IK03.Lumen output of 4650 lumens.Life class of 50,000 hrs @ L70, Operating Temperature:-10 TO +45 DEG.C; Input Supply Voltage Range:140-270 V, Frequency :50-60 HZ; Internal Surge Protection:3 KV. The luminaire shall be designed so as to ensure L70B50 @ 30K Hrs.@ 45 Degree Ambient. The electronic driver used shall have a power factor >0.95 and THD <10% The fixture should comply with the parameters as per IS10322. Similar to SM367 LED42S-6500 G6 L54W54 PSU OD

36W to 40W 2X2 LED flat panel Lighter

- **Integral driver LED 5W** wall light with a system lumen output of 40 lumens and a minimum system efficacy of 10 lm/W. The luminaire shall have a rated system lifetime of 25,000 burning hours at L70. The luminaire should have a color temperature of 3000K/4000K57000K/6500K and CRI > 75. The luminaire shall meet IP67 rating with THD < 20% and PF > 0.9. The luminaire shall have polycarbonate diffuser.

LED 5W wall Lighter

- **20W wall mounted 4ft luminaire** of CRCA housing and PC diffuser (Diffuser-Non yellowing type). The luminaire should have a LEDs with colour consistency SDCM ≤ 5, CRI ≥ 80 and CCT of 3000K/4000K/5700K/6500K. Luminaire shall be designed to emit at least 2000 nominal lumens at a system efficacy of at-least 120 lumen/watt. Power consumption should not be more than 16W (±5%). The Life of fixture (Including Driver):50000 burning Hrs. @ L70B50 Lumen maintenance @ design ambient temp 45 deg C. The electronic driver used shall have a power factor ≥0.95 and THD ≤10%, suitable for an operating voltage range of 140-270V AC, Current Ripple ≤5%, Internal surge protection should be minimum 4KV, electrical insulation class should be Class I & driver should be of Class B serviceability.The luminaire should be at least IP20 & IK02 rated. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" as per IS 10322. The LED Luminaire

20W wall mounted 4ft luminaireLighter

- **20W 2X2 Recess LED** flat panel for which provides soft-light and glare free symmetrical illumination..CRCA powder coated white after phosphochromate treatment and High transmittance polystyrene opal diffuser. High efficiency long life LED package in integral module with system lumen efficacy of >95 lm/W and viewing angle of 120° to ensure better uniformity.Powered by built-in Isolated, SELV Output electronic LED driver (SMPS based constant current supply) with Output Short-circuit protection, Surge protection & other reliability test. CRI >80, Color temperature 3000K/4000K/5700K/6500K, THD <20% and PF >0.95,IP20, IK03.Lumen output of 2400 lumens.Life class of 50,000 hrs @ L70, Operating Temperature:-10 TO +45 DEG.C; Input Supply Voltage Range:140-270 V, Frequency :50-60 HZ; Internal Surge Protection:3 KV.

20W 2X2 Recess LED flat panel Lighter

- **Surface mounted 10/12 watt LED type Bulk-head** fitting 1100lm made up of pressure die-cast aluminium housing and Polyster Powder coated with High quality polycarbonate diffuser in opal finish for glare free light distribution.High efficiency long life LED module with SMD LED package efficacy of >110 lm/W. Powered by integral electronic LED driver with CCT 3000K/4000K/5700K/6500K, CRI>80,THD<10%, PF>0.9, IP66, IK 09, Life class of 50,000 hrs @ L70, Operating Temperature: 0 TO +45 DEG.C; Input Supply Voltage Range:140-270 V, Frequency :50-60 HZ. Driver Safety requirement standards:IS 15885, Test Report to be submitted, Photobiological Safety Norms: IS 16108, test Certificate to be submitted, Certification: LM79 for Luminaire, Lm80 for LED Source.

10/12 watt LED type Bulk-head Lighter

- **Surface mounted 10 watt LED** vertical downlighter having dia of 130mm(± 3mm) & height of 60mm(± 3mm) delivering minimum system lumen output of 1000 lumens (±5%) and system wattage of 10W (±5%) & with a minimum system efficacy of 100 lm/W. The luminaire should have a color temperature of 3000K/4000K/57000K/6500°K, CRI≥80 and SDCM≤5. The driver shall have THD≤10% (@full Load) and PF ≥ 0.95 (@full load). The luminaire housing should made of pressure die-cast aluminum. The fixture should comply with the parameters as per IS10322. The luminaire shall have impact resistance of IK02 & ingress protection of IP20. Luminaire manufacturer must have In-house NABL accredited lab to conduct LM79, Type test as per IS10322 & "FAT" as per IS 10322.

Surface mounted 10 watt LED Lighter

- **Recess mounted 70 watt LED** High bay vertical down lighter complete with all accessories and replaceable electronic driver, directly on false ceiling including connection with 1.5 sq.mm FR PVC insulated copper conductor cable and earthing the body etc.

70 watt LED High Bay Lighter

- **Aviation obstruction light with Light Emitting Diods (LEDs)** similar to Bajaj make cat no. BGAV 302 LED or its equivalent as per approved list of make complete with all accessories.

Aviation obstruction Lighter

Wall fans

The relevant standards would be the Indian Standard (IS) and the Electrotechnical Commission (IEC) standards. Here are the key standards

IS 555: This is the Indian Standard for wall mounted fans. It specifies the general requirements constructional details, and performance characteristics of electric wall mounted fans.

IEC 60335-2-80: This is the International Electrotechnical Commission standard that applie to the safety of electric fans, including wall mounted fans. It covers safety requirements related to construction, insulation, temperature, protection against electric shock, and other aspects.

Both standards ensure that wall mounted fans meet specified safety, performance, and quality requirements. Manufacturers and importers typically adhere to these standards to ensure compliance with regulatory requirements and to provide safe and reliable products to consumers.

Wall fans

Exhaust fans

The relevant standards include both Indian Standards (IS) and International Electrotechnical Commission (IEC) standards. Here are the key standards.

IS 2312: This Indian Standard specifies requirements for exhaust fans, including design, construction, performance, and testing methods. It covers aspects such as air flow rate, power consumption, noise levels, and safety requirements specific to exhaust fans.

IEC 60335-2-80: This International Standard applies to the safety of electric fans, including exhaust fans. It covers general safety requirements related to electrical components, insulation, temperature, protection against electric shock, and mechanical hazards.

These standards ensure that exhaust fans manufactured and sold in India (IS 2312) and globally (IEC 60335-2-80) meet established criteria for safety, performance, and quality. Manufacturers typically adhere to these standards to ensure compliance with regulatory requirements and to provide consumers with safe and reliable products that meet international norms.

Exhaust fans 150MM

Exhaust fans 300MM

Ceiling Fan

These standards ensure that BLDC ceiling fans manufactured and sold in India (IS 374) and globally (IEC 60335-2-80) meet established criteria for safety, performance, and quality. Manufacturers typically adhere to these standards to ensure compliance with regulatory requirements and to provide consumers with safe and reliable products that meet international norms.

A 1200 mm sweep ceiling fan with a BEE 5-star rating and a Brushless Direct Current (BLDC) motor is designed for high efficiency, energy savings, and optimal performance. Here's a comprehensive overview of the specifications, features, and considerations for such a ceiling fan:

Technical Specifications

1. General Description:

Sweep Size: 1200 mm (approximately 48 inches)

Rating: BEE 5-star (Bureau of Energy Efficiency rating for high energy efficiency)

Motor Type: Brushless Direct Current (BLDC) motor for quiet and efficient operation

2. Electrical Specifications:

Power Consumption: Typically between 30W and 50W, depending on design and speed settings

Voltage: 230V AC, 50Hz (standard voltage for most regions)

Motor Type: BLDC (Brushless DC Motor)

Speed Settings: Usually includes 3 to 5 speed settings

Ceiling Fan 1200MM

5.33. IV CABLE, CABLE TRAY & TERMINATION

Description of Work

Supply, laying, testing and commissioning of cables as per specifications, schedule of quantities and drawings.

Applicable Codes & Standards

IS: 10242 (Part-3, Section-12) : Installation of cables for low voltage system

IS: 7098 (Part-1&2)/IS: 5831/

IEC: 60502/BS: 6746/BS:5467	:	Cross linked polyethylene insulated PVC sheathed cables.
Part-I	:	For working voltages up to & including 1100 Volts.
Part-II	:	For working voltage from 3.3 KV up to & including 11KV.
IS: 10810	:	Method of test for cables
IS: 1255	:	Code of practice for installation & maintenance of power cables up to & including 11KV rating.
IS: 8130/IEC: 60228	:	Conductors for cables
IS: 10418	:	Drums for electric cables.
IS: 2062, IS: 800, IS: 816	:	Structural wedding steel

Submittals

Cable schedule as per site conditions & good for construction drawings.

Layout of various cables on cable tray / trench along with sections showing no. of cables, distance between cables etc, size of cable trays etc.

Cable tray layout, as per site condition, duly coordinated with other services.

Test reports

Routine test certificates for each drum of cable brought to site.

Specifications

General

Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

Material

The MV power cable of 1100 V and upto 16 sq.mm shall be XLPE insulated & PVC sheathed copper conductor armoured cable as per relevant IS.

The MV power cable of 1100 V and above 16 sq.mm shall be XLPE insulated & PVC sheathed Aluminium conductor armoured cable as per relevant IS.

The MV control cables shall be PVC insulated copper conductor armoured cable.

The HT power cable of 11KV grade shall be XLPE insulated Aluminium conductor armoured cable.

The cable shall be Supply, installation, testing & commissioning of LPCB approved Fire armoured cable as per BS 7846, fire Test as per BS 6387 CWZ, copper conductor /mica taped/ Flame Barrier/ Cross Linked Insulation/ Halogen Free Inner Sheath/ SWA/ Halogen Free Outer Sheath (1000V), LPCB Certified for power cables.

Installation

General

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S. 1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the Contractor & approved by Engineer-in-Charge.

Proximity to Communication Cables

Power and communication cables shall as far as possible cross at right angles. Where power cables are laid in proximity to communication cables the horizontal and vertical clearances shall not normally be less than 30 cm.

Cable Laying Direct in Ground

General

This method shall be adopted where the cable route is through open country along roads/lanes etc. and where no frequent excavation are encountered and where excavation is easily possible without affecting other services.

Trenching

Width of Trench: The width of trench shall be determined on the following basis:

a) The minimum width of trench for laying single cable shall be 35 cm.

b) Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that the inter-axial spacing the cables, except where otherwise specified shall be at least 20 cm.

c) There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

Depth of Trench: The depth of trench shall be determined on the following basis:

a) Where cables are laid in single tier formation, the total depth of trench shall not be less than 75 cm. for cables up to 1.1 KV and 1.20 m for cables upto 11KV.

b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in a (i) above shall be increased by 30 cm. for each additional tier to be formed.

Excavation of Trenches

a) The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided complying with the requirements.

b) Where gradients and changes in depth are unavoidable, these shall be gradual.

c) Excavation shall be done by any suitable means-manual or mechanical. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench.

d) Adequate precautions shall be taken not to damage any existing cables, pipes or other such installations in the proposed route during excavation. Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried without the approval of the Engineer-in-Charge.

e) Existing property exposed during trenching shall be temporarily supported or propped adequately as directed by the Engineer in charge. The trenching in such cases shall be done in short lengths, necessary pipes laid for passing cables therein and the trench refilled.

f) If there is any danger of a trench collapsing and endangering adjacent structures, the sides should be well shored up with timbering and/or sheeting as the excavation proceeds. Where necessary, these may even be left in places when back filling the trench.

g) Excavation through lawns shall be done in consultation with the staff of the department/Engineer-In-Charge concerned.

h) The bottom of the trench shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm. in depth.

Laying of Cable in Trench

a) At the time of issue of cable for laying, the cores shall be tested for continuity and insulation resistance.

b) The cable drum shall be properly mounted on jacks or on a cable wheel, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum without failure and that the spindle is horizontal in the bearings so as to prevent the drum creeping to one side while rotating.

c) The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire cable length shall as far as possible be pulled of in one stretch. However, where this is not possible the remainder of the cable may be removed by 'Flaking' i.e. by making one long loop in the reverse direction.

d) i) After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted slightly over the rollers beginning from one end by helpers standing about 10 m apart and drawn straight. The cable should then be taken off the rollers by additional helpers lifting the cable and then laid in a reasonably straight line.

ii)For short runs and sizes up to 50 Sq. mm of cables up to 1.1 KV grade, any other suitable method of direct handling and laying can be adopted with the prior approval of the Engineer-in-Charge.

e) When the cable has been properly straightened, the cores shall be tested for continuity and insulation resistance. In case of PVC cables, suitable moisture seal tape shall be used for this purpose.

f) i) Cable laid in trenches in a single tier formation shall have a covering of clean, dry sand of not less than 17 cm above the base cushion of sand before the protective cover is laid.

ii) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cm shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cm. as stated above. The top most cable shall have a final sand covering not less than 17 cm. before the protective cover is laid.

g) At the time of original installation, approximately 3 m of surplus cable shall be left on each end the cable and on each side of underground joints (Straight through/Tee/Termination) and at entries and places as may be decided by the Engineer-in-Charge. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length loose cable may be left at suitable intervals as specified by the Engineer-in-Charge.

h) A final protection to cables shall be laid in accordance with Clause j to provide warning to future excavators of the presence of the cable and also to protect the cable against accidental mechanical damage by pick-axe blows etc.

i) Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20 cm x 10 cm x 10 cm (nominal size) as per CPWD Building Specification or protection covers placed on top of the sand, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Engineer-in-Charge. Where more than one cable is to be laid in the same trench, this protective covering shall cover all the cables and project at least 5 cm. over the sides of the end cables.

Back Filling

a) The trenches shall be back-filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm. In the centre and tapering towards the sides of the trench shall be left to allow for subsidence. The crown of earth however should not exceed 10 cm. so as not to be a hazard to vehicular traffic. The temporary re-instatements of roadways should be inspected at regular intervals, particularly during the wet weather, and any settlement should be made good. Further trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved in accordance with the relevant Specifications to the satisfaction of the Engineer-in-Charge.

b) Where road berm or lawns have been cut or kerb stones displaced, the same shall be repaired and made good except turfing/asphalting to the satisfaction of the Engineer-in-Charge and all surplus earth or rock removed to places as specified.

Route Markers

a) Route markers shall be provided along straight runs of the cables at locations approved by the Engineer-in-Charge and generally at intervals not exceeding 100 m. Markers shall also be provided to identify change in the direction of the cable route and also for location of every underground joint.

b) Route markers shall be made out of 100 mm x 100 mm x 5 mm GI/Aluminium plate, welded or bolted on to 35 mm x 35 mm x 6 mm angle iron 60 cm. long. Such plate markers shall be mounted parallel to and 0.5 m or so away from the edge of the trench.

c) Alternatively cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) marker 60 cm x 60 cm 10 cm in size shall be laid flat and centred over the cable. The concrete markers unless otherwise instructed by the Engineer-in-Charge shall project over the surrounding surface so as to make the cable route easily identifiable.

d) The work 'cable' and other details such as voltage grading, size etc. as furnished by the Engineer-in-Charge shall be inscribed on the marker.

Laying in Pipes / Closed Ducts

In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the Civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embedded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. from the ground level when laid under roads, pavement etc.

Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of poly phase system.

The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

Manholes of adequate size as decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons. They shall

be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Engineer-in-Charge through another agency.

Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.

All chases and passages necessary for laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge.

Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

Laying on Cable Tray

Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.

The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, and structural steel members (comprising of channels, angles, flats, rods) for structural supports for cable trays etc.

Cable Tray Mounting

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out ensuring the following:

a) Cable tray mounting arrangement type to be as marked on layout drawing.

b) Assembly of tray mounting structure shall be supplied, fabricated, erected & painted by the Contractor.

c) Cable tray running along the wall should be supported at intervals not exceeding 1.5 m. In case of branching, there should be a support on all branches at a distance of 30 cm from the point of branching. Support should not be less than 40 mm x 40 mm x 5 mm MS angle-secured in an approved manner where runs are along the walls. In case of ceiling suspended cable tray horizontal supports made of 40 mm x 40 mm 5 mm MS angle iron shall be provided. The horizontal interval between two such supports shall be 1.0 meter. These supports shall be suspended from C.I. boxes or suitable approved suspension devices such as dash fastener of suitable sizes in the ceiling by means of 10 mm diameter GI threaded rods. All above mounting accessories form part of installation of cable trays.

Testing & Commissioning

Inspection

All cables shall be inspected upon receipt at site and checked by the Engineer-in-Charge for any damage during transit.

Testing

i. All 650/1100 Volt grade cables before laying shall be tested with a 500 V megger or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/amour and insulation resistance between conductors.

ii. All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

Completion Plan and Completion Certificate

a) After completion of the work the Contractor shall draw completion plans to a suitable scale and shall submit to the Engineer-in-Charge. The completion plans shall, inter-alia, give the following details

i) Layout of cable work

ii) Length, size, type and grade of cables.

iii) Method of laying i.e. direct in ground, in pipes etc.

iv) Location of each joint with jointing method followed.

v) Route marker and joint maker with respect to permanent land marks available at site.

vi) Wherever the previously laid cable is cut and additional joints are introduced etc., the cable records shall suitably be amended.

Testing of Cables

The cables shall be tested before and after laying. The Megger value in normal dry weather shall be 50 Mega ohm for 1.1 KV grade cable. This value shall be 200 Mega ohm for 11KV grade cable.

Cable Tags

Cable tags shall be made out of 2mm thick aluminium sheets. Each tag shall be 2” in dia or 3” x 3” square with one hole of 2.5mm dia, 6 mm below the periphery, or as approved by Consultant. Cable designations are to be punched with letters / number punches and the tags are to be tied to cables with piano wires of approve quality & size. Tags shall be tied inside the panels beyond the glanding as well as above the glands at cable entries. Along trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 meters.

Cables shall be secured to cable trays with 3mm thick x 25mm wide aluminium strips/suitable GI clamp, or as approved by Consultant, at 1000 mm intervals and screwed by means of rust proof screws and washers, of adequate but not excessive lengths. Cable trays for horizontal runs suspended from the ceiling will be supported with mild steel straps or brackets, at 1000 mm intervals and the overall tray arrangement shall be of a rigid construction. External cabling route marker with C.I. plate marked with "DANGER 1.1 KV CABLE" with 0.6 meter long GI angle iron grouting bracket including 1:3:6 ratio cement concrete base block of minimum size 200 x 200 x 350 mm to be provided or as approved by Elect. Supply Company.

Cable Tray

All cables trays shall be made of G.I. sheet.

Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays. The bends, Tee joint, Cross joint for all sizes of cable tray shall be factory fabricated.

Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

Perforated Cable Tray

Standard dimensions of perforated cable trays shall be as follows:

1. Width	:	100 mm to 900 mm
2. Length	:	2500 mm
3. Thickness 900mm to 1200 mm	:	2mm up to 750 mm width and 3mm from
4. Collar height to 1200mm	:	50 mm up to 600 mm and 75 mm from 750 mm

Ladder Type Cable Tray

Standard dimensions of ladder type cable trays shall be as follows:

Size of tray	**size of main channel**	**size of rung /spacing between rungs**
900mm to 1200mm	25 x100 x 25 x 3mm	20 x 50 x 20 x 2 @ 200C/C
Up to 750mm	25 x 75 x 25 x 2mm	20 x 50 x 20 x 2 @ 200C/C

Sizes of angle for cable tray supports shall be minimum 40 x 40 x 5 mm up to 600mm & 50 x 50 x 5mm minimum as specified in the drawings/schedule of quantities for sizes above 600 mm. Hangers shall be of minimum 10 mm dia steel round bars up to 600 mm & 12 mm dia steel from 750 mm to 1200 mm as specified in the drawings/schedule of quantities. All the support shall be G.I.

Fixing arrangement shall be as approved by the Consultant.

Hardware to be used in cable tray system shall be galvanized or zinc passivated.

5.34. V. RACE WAY & JUNCTION BOARD

Race way

All Race way shall be made of of GI sheet.

Race ways shall be complete with bends, joints, coupler plates and accessories as may be required for joining the race way. The bends, Tee joint, Cross joint for all sizes of cable Race way shall be factory fabricated.

Race way shall be either perforated or under floor/ceiling type as called for in the schedule of quantities.

Perforated Race Way

Standard dimensions of perforated cable trays shall be as follows:

1. Width	:	100 mm to 300 mm
2. Length	:	2500 mm
3. Thickness mm to 750 mm	:	2mm up to 300 mm width and 3mm from 300
4. Collar height to 1200mm	:	50 mm up to 600 mm and 75 mm from 750 mm

Under floor / ceiling Type Race Way

Standard dimensions of under floor/ceiling type race way shall be as follows:

Size of race way	size of main channel	size of rung /spacing between rungs
Up to 300 mm	25 x 75 x 25 x 2mm	20 x 50 x 20 x 2 @ 200C/C

Sizes of angle for race way supports shall be minimum 40 x 40 x 5 mm up to 600mm & 50 x 50 x 5mm minimum as specified in the drawings/schedule of quantities for sizes above 300 mm. Hangers shall be of minimum 10 mm dia steel round bars up to 300 mm & 12 mm dia steel from 750 mm to 1200 mm as specified in the drawings/schedule of quantities. All the support shall be G.I. Fixing arrangement shall be as approved by the Consultant. Hardware to be used in race way system shall be galvanized or zinc passivated.

5.35. VI. UPS SYSTEM

System Components

The Capacity to be designed as per the electrical SLD in Insulated Gate Bipolar Transistor (IGBT) Technology.

Product Certification / Testing

The product shall have certification from any one of the following -

a) ERTL

b) ETDC

c) Sameer

d) STQC

e) IEC

f) ISO 9001

Operating Temperature

0-40 degree Centigrade

Humidity

Upto 90%

Output Frequency

50 Hz +/- 0.01% Hz

Wave Form

Pure Sine Wave

Transient Response

+/- 1% maximum under following conditions:

a) Loss or Return of Input AC supply

b) 100% step load

Load Power Factor

0.9 lag to unity.

Crest Factor

Greater than 3:1

Switch Over Time

Zero

Overload Rating

110% for 30 minutes

125% for 01 minutes

Switching speed

Minimum 2 KHZ

Indication

Mains ON/OFF, /Battery HIGH/LOW, Battery ON, Invertor ON/TRIP, O/P HIGH/LOW, Battery HIGH/LOW, Alarm for Battery Discharge.

Protection

Input - Over/Under voltage, Over Current.

Battery - Over/Under Voltage, Over Current, Battery Low Alarm/Trip.

Output - Over/Under Voltage, Over Current.

Output - Short Circuit Over Temperature DC Over Current

Control Circuitry

Microprocessor based control circuitry be provided and all indications will be digitally displayed using microprocessor based software.

Metering

Digital display with multifunctional key panel indicate.

Output Voltage/Current

DC Voltage/Current

Output Frequency

Communication Port

RS 232, RS 485

Diagnosis & Configuration Software

Compatible with Unix/Windows.

Out Look

Compact size with aesthetically good look (specify the size and weight)

Battery

Lead Acid, S.M.F. for 20 minutes back-up under full load. Battery sizing calculations to be submitted

Ups Failure

During failure in the UPS equipment the static switch automatically transfer the A.C. load directly to the AC. line in less than 1/4 cycle so that transfer does not affect critical equipment operation.

Harmonic Distortion of Wave Form

Total harmonic distortion (THD) should be below 3% for linear load and below 5% for nonlinear load.

Maintenance by Pass Switch

The portion of UPS module used to connect the alternator supply to critical load while electrically isolating static switch and inverter for maintenance purpose.

Battery Disconnect Switch

The switch used to electrically isolate the storage batteries from UPS module.

Static Transformer Switch

The switch senses an inverter shutdown signal or degradation of inverter output item.

It shall automatically transfer the loads from one inverter to the alternative AC power without interruption.

Retransfer to Inverter

The static transfer switch shall be capable of automatically retransferring the load back to inverter after the inverter has returned to normal voltage and stabilized forperiod of time.

Quality Assurance

The manufacturer shall have quality assurance program with check on incoming parts and final products. A final test procedure for product shall include a check of all performance specifications and a minimum 24 hour running.

Installation Drawing

The minimum two sets of installation drawings showing outline dimension, weights and connections and a one line drawing of the UPS shall be sent to the purchaser to be used in planning the installation of the system.

Product Documentation

Manufacturer shall supply a comprehensive set of product documentation for:

1. Installation
2. Operation
3. Maintenance

This should include complete outline and external connection drawings and schematic and physical wiring diagrams as well as parts list and parts layout down to the smallest components level. It should include startup and service manuals with complete privation and remedial maintenance and trouble showing instructions. This should include all ancillary equipment and accessories.

Training

It is important that at least -2 personnel who are to be responsible for operation and maintenance of UPS be trained at the manufacturer site.

Spare Parts

The recommended spare parts to be listed and should be quoted along with main modules as per manufacture defects

Material and Workmanship

1) Workmanship shall be first class in every respect.
2) All material shall be new and of best commercial grade.
3) Brackets and securing hardware shall be electroplated with corrosion resistance material.
4) Internal wiring conductors shall be combined into cable or bundles and shall be tied securely together and numbered or coded to correspond with documentation.

Storage Battery

The storage battery shall be furnished with racks connecting hardware and standard service resistance material accessories. The battery shall be delivered charged and filled ready for service.

Service Report

Assigned field service report describing start-up and on site testing shall be furnished.

Maintenance

If the battery is taken out of service for maintenance by manually opening battery disconnect switch the UPS shall continue to function and meet all the performance criteria specified except.

Inverter efficiency

94% minimum

Protection class

IP – 20

Warranty

The date of Invoice UPS & Battery For 24 MONTHS as per manufacture defects.

5.36. C. PA SYSTEM WORK

Basis of Design

Purpose

1. The purpose of the system is to quickly evacuate people in an orderly manner via escape routes through the use of prepared clear text instructions. In addition, it should be capable to take all instructions that are announced live to be sent to circuits and groups.
2. The scope includes the design supply, installation and commissioning of a audiable and intelligible Public Address and voice alarm system and should be designed such that it could be integrated with existing fire alam panel.

Standards

1. The Public Address & Voice Alarm system should be EN54-16 complied for the VA/PA system.
2. Compliance shall be verified by means of a manufacturer declaration, CPD certificate or by obtaining approval from certification authority with the VA/PA system provided and its additional components

Definitions

1. PA: Public Address
2. Zone: Separate group of loudspeakers and associated supply wiring that may be arranged for selective switching between different channels.
3. Public Address (PA) Zone: A collection of one or more Zones. Each PA Zone shall be provided with an independent paging button, allowing a unique paging to be independently addressed to that Zone or collection of Zones. PA

Zones are provided to permit messages or other audio content to be independently transmitted to selected areas.

4. Voice Alarm Zone: A collection of PA Zones that are to receive a simultaneous emergency announcement. Voice Alarm Zones are used to permit phased evacuation.
5. Voice Alarm System: A fully functional and resilient emergency speech annunciation system, as specified in this section, including control equipment, microphones, loudspeakers, interfaces and all associated interconnections.
6. Fire Alarm System: For the purposes of this section of the specification, the Fire Alarm system shall form, in conjunction with the Voice Alarm system, the complete Fire Alarm and Detection system.
7. STI: Speech Transmission Index as described in IEC 60268-16: 2003.

System Components

IP Based Digital Audio Controller

a. Digital audio distribution and connection system for up to 8 / 24 loudspeaker zones
b. Module with audio signal processing for connecting and controlling power amplifiers and for connecting loudspeaker circuits.
c. Four independent audio outputs for connecting power amplifiers (up to 400W per channel) and for simultaneous processing of up to four different audio information items per module.
d. Connection of audio signal to one or up to six user-defined loudspeaker zones for each audio output to obtain upto twenty-four loudspeaker circuits per module.
e. Upgrade to a complex alarm/public address system through integrated LAN interfaces.
f. Continuous monitoring of power amplifiers by means of a 22 kHz test tone. In the event of a failure of a power amplifier, a backup amplifier will automatically and dynamically replace the faulty power amplifier. The defined loudness level is also taken into account for the backup amplifier.
g. Continuous inaudible monitoring of loudspeaker lines (ground faults, short circuits, interruptions, and impedance deviations with specified tolerances for each loudspeaker circuit), even in power- saving mode, independent of activated announcements. An end of line module can also optionally be used as a line termination and the line to the EOL can be monitored. This ensures that short-circuited loudspeaker circuits are disconnected without affecting the rest of the system.

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

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

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

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

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

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

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

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

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

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

r. Emergency 24 V power supply as secondary power supply.

Display

a. LEDs for device operating state:

b. In operation,

c. Warning/error

d. Emergency control option

e. Power-saving mode

f. 8 LEDs for indicating the control contacts state

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

h. 24 error and 24 loudspeaker circuit relay LEDs

Operating elements

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

b. 1 monitoring loudspeaker

Audio output

a.	Output type	: electronically symmetrical
b.	Nominal level	: 0 dBu
c.	Max. output level	: +6 dBu
d.	Frequency range	: 20 Hz to 20 kHz
e.	Max. deviation from linear frequency	: ± 1 dB in frequency range
f.	Distortion factor at nominal level	:< 0.03% at 1 kHz
g.	Max. distortion factor	:0.1% in frequency range
h.	Signal-to-noise ratio at nominal level	:>75 dB (A) > 70 dB
i.	Load impedance	:min. 5 kΩ, max. 500 pF
j.	Sensor input (AVC)	

Input type symmetrical, non-earthed

a.	Nominal level	-	51 dBu
b.	Nominal level for emergency call station	-	0 dBu
c.	Frequency range	-	100 Hz to 8 kHz
d.	Max. deviation from linear frequency	-	± 6 dB in frequency range
e.	Distortion factor at nominal level	-	< 0.2% at 1 kHz
f.	Max. distortion factor	-	1% in frequency range
g.	Signal-to-noise ratio at nominal level	-	> 65 dB (A) > 60 dB
h.	Input impedance typ.	-	200 Ohm

Control contacts

a.	Max. voltage	:	100 V DC/1 A
b.	Impulse withstand voltage	:	> 2.5 kV
c.	Pass-through contacts	:	
d.	Max. voltage	:	250 V AC, 30 V DC/5 A
e.	Impulse withstand voltage	:	> 1.5 kV
f.	Power supply	:	
g.	Rated voltage	:	90 V AC to 264 V AC

h.	Nominal frequency	:	47 Hz to 440 Hz
i.	Power rating with/without AC 230 V	:	4x DAL 50 W/80 W at
j.	Emergency power supply	:	
k.	Voltage range	:	21.6 V DC to 30 V DC
l.	Ambient temperature range	:	-5°C to +55°C
m.	Relative humidity	:	15% to 90%
n.	*AVC = Automatic Volume Control		

Amplifiers

Power amplifier 2 x 250 W/100 V; class D, 24 VDC

a. The power amplifier includes the following characteristics:
b. Complies with IEC BS EN 60268-3, 55013, and 55020 standards
c. Self-monitoring and self-testing via microcontrollers
d. Protected against overload, short circuits and over-heating
e. Built-in fan with temperature-controlled rotation speed control, with airflow from
f. front to back of device
g. Monitoring of the fan's t self, if one is failed – the left fan must set on 100%
h. speed automatically

Power amplifier 2 x 500 W/100 V; class D, 24 VDC

The power amplifier includes the following characteristics:

a. Complies with IEC BS EN 60268-3, 55013, and 55020 standards
b. Self-monitoring and self-testing via microcontrollers
c. Protected against overload, short circuits and over-heating
d. Built-in fan with temperature-controlled rotation speed control, with airflow from front to back of device
e. Monitoring of the fan's t self, if one is failed – the left fan must set on 100% speed automatically

Ceiling Loudspeakers (6W/3W/1.5W/0.75W): EN 54-24 certified 6W ceiling loudspeaker with the following specifications

Max power	:	9 W
Rated Power	:	6 W
Power taps @ 100V	:	6 W / 3 W / 1.5 W /
0.75 W SPL (1W / 1m, 100 Hz - 10k Hz)	:	91 dB
Frequency response (- 10 dB)	:	170 Hz - 20k Hz

Dispersion angle (1k Hz / -6 dB)	:	170°
Rated input voltage	:	100 V
Rated impedance	:	1.7k Ω/3.3k Ω/6.7k Ω/13k Ω

6W/3W/1.5W/0.75W Wall mount Loudspeaker : EN 54-24 certified 6W wall amount loudspeaker with the following specifications

Max power	:	9 W
Rated Power	:	6 W
Power taps @ 100V	:	6 W / 3 W / 1.5 W / 0.75 W
SPL (1W / 1m, 100 Hz - 10k Hz)	:	91 dB
Frequency response (- 10 dB)	:	300 Hz – 15 k Hz
Dispersion angle (1k Hz / -6 dB)	:	170°

Execution

Cable Installation

1 The system wiring shall comply fully with the requirements of this Specification.

2 The work should comply to relevant IBC and ANSI standards and shall be responsible for the operation and performance of the system, including wiring.

3 Cables [wiring & fiber], regardless of length, shall be marked with wraparound number or letter cable markers at both ends. All cables shall have a unique reference number. There shall be no unmarked cables at any place in the system.

4 Inter-rack cabling shall be neatly strapped, dressed, and adequately supported. Terminal blocks, boards, strips, or connectors, shall be furnished for all cables which interface with racks, cabinets consoles, or equipment modules. Fire alarm rated cable shall be used

5 Alternate loudspeakers shall be wired to independent circuits, on the A/B principle as specified herein, if need be.

6 Cores shall be color coded or numbered.

7 In-line connections shall be limited to the absolute minimum practicable. Any such connections shall be within suitable steel junction boxes, color red, permanently annotated 'VOICE ALARM SYSTEM'.

8 Connections to equipment racks shall be via marshalling boxes, color red, also annotated 'VOICE ALARM SYSTEM'. The boxes shall be fitted with fixed terminal strips, which shall be permanently annotated with unique circuit reference numbers. Final connections between the marshalling boxes and the racks shall be via suitable flexible cables of sufficient length to gain working access to the rear of the racks.

9 Internal rack connections shall be either hard-wired or via professional type audio connectors, preferably of the latching type.

10 Terminate conductors; no cable shall contain un terminated elements. Make terminations only at outlets and terminals.

11 Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables shall not be spliced.

12 Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

13 Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

14 Separation of Wires: Separate speaker-microphone, line-level, speaker level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer. Cables shall only cross at right angles.

Installation of PA equipment and racks

1 Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

2 Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams

Equipment Cabinets and Racks

1. Group items of same function together, either vertically or side by side, and arrange controls symmetrically. Mount monitor panel above the amplifiers.
2. Arrange all inputs, outputs, interconnections, and test points so they are accessible at rear of rack for maintenance and testing, with each item removable from rack without disturbing other items or connections.

Blank Panels

Cover empty space in equipment racks so entire front of rack is occupied by panels.

Grounding

1. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

2. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

Testing & Inspection

a) After complying with the procedures set out in the Preliminaries, the full tests shall be carried out to demonstrate that the works meet the requirements, in accordance with this Specification.

b) A method statement shall be provided to the Engineer-in-Charge for approval at least 10 days before the tests are scheduled to commence. Upon successful completion of these tests, full system demonstration shall be done for acceptance purpose.

c) The test shall include, but not necessarily be limited to:
i. Full operational tests on the rack equipment and system inputs, including a complete check on input routing and priority;
ii. Test of interfaces to the fire detection system;

d) Impedance of each loudspeaker line

e) Electrical safety and earth checks (by a competent person, to be approved);

f) Sound level measurements, to ensure that the system sound levels for each input meet the Specification requirements;

g) Equalisation of the system in each zone;

h) Set up of time delay to loudspeakers;

i) Set up and test of the ANS system;

j) Subjective assessment of the electro acoustic performance of the system, including the intelligibility of speech.

k) Signal Ground Test: Measure and report ground resistance at pubic address equipment signal ground. The test report shall include:

l) Test details - dates, times, test personnel (with qualifications as appropriate); 5 Measured values in appropriate format for the parameter measured, e.g.

m) Marked-up drawings and tables showing electro acoustic performance and completed matrices proving correct priority and routing operation.

n) The sound level measurement procedure shall be as follows:

o) The sound level meter shall be calibrated immediately before commencing the measurements. The sound level meter shall be set to dB(A), slow (‘S’) response.

p) Measurements shall be taken at 1.5m above floor level (1m above floor level in seating areas.

q) The pink noise input gain setting shall be noted and used to set up the sound levels at all other locations. One zone shall be selected at a time to minimize disturbance.

r) Measurements shall be taken in all areas of the building covered by the system.

s) Measurement locations shall be chosen to indicate the maximum range of sound levels within an area.

t) Measurement locations and corresponding sound levels shall be marked up on the loudspeaker layout drawings. The drawings shall also indicate the final tapping value of each loudspeaker or each set of similar loudspeakers. If the measured sound levels do not meet the required levels then adjustments shall be made to the pre-amplifiers, amplifiers and/or loudspeaker tappings. The documented levels shall be the measured levels after adjustment. Any areas where the required levels cannot be achieved shall be highlighted on the drawings.

u) The pink noise test shall ensure that the relative sound levels between different areas are correctly set. Once this is completed each system input needs to be set correctly. This shall only involve measurements at 2 locations and adjustment of the pre-amplifier setting of each system input.

v) Each of the recorded messages shall be broadcast and measured in turn. The sound levels of any pre-announcement tone and of the spoken message shall be measured and noted separately. The sound level shall be the dB(A) visual average or Leq over the length of the preannouncement tone or the spoken message.

w) Adjustments shall be made to the pre-amplifier setting until the measured sound level of the spoken message meets the required sound level.

x) The sound levels produced by each microphone input shall be measured and adjusted until the required sound levels are reached. Each microphone output shall be assessed using 3 different voices, repeating the words of the test message.

y) The levels shall be set such that the arithmetic average of the three measured levels agrees with the target level. The microphones shall be used with the lips at the appropriate working distance from the microphone head. This distance shall be recorded with the documented sound levels.

z) Upon successful completion of the tests full system demonstration shall be done for acceptance purpose.

Warranty/Guarantee As per Manufacturing Defects

5.37. ELV AND ICT SYSTEM

I Passive (Data, Wi-Fi & Networking System)

Computer/ LAN Networking/ Wi-Fi Points

The system has to provide Cat 6A RJ 45 data outlets points for Computers, Networking, Telephones, Wi-Fi, Access Control, CCTV, Information Display system, Systems, BMS, SCADA etc. as per requirement in rooms and other areas at various floors in all the blocks/ buildings.

The Data Outlet points shall be connected to Rack Panel/Computer hub with 4 pair CAT-6A wiring in Raceways, recessed/ surface conduit as required. UPS Power supply shall be provided to Network Rack, Servers & Computers wherever required.

The maximum length of the CAT-6A cable from end user point to the Hub or Edge switches shall not be more than 90 M. Beyond 90 M length Fiber Optic Cable shall be used.

The Rack Panel/computer hub at various floors will be connected to Main rack of the building/ block with Fiber Optic Cable through conduit or raceways on surface/ recess.

Suitable Data center with false flooring shall be established in Administrative Building, which comprises both LAN server & IPABX server. There shall be proper redundant (24 X 7) cooling facility in the Data center to maintain the desired temperature, humidity & Indoor air quality for smooth operation of the System.

The server shall be connected to Core Switch and Core switch to Distribution Switch between Connectivity Minimum 40G and switch shall be through Optical Fibre cable. Distribution to edge switch connectivity minimum 10Gand each building/ block with optical fiber cable in underground DWC HDPE pipe of suitable size for outside connectivity or in cable raceway/conduit inside the buildings.

The Network shall have Core switches, distribution switches, Firewall protection, Load balancer Bandwidth management, ITAM all in redundant mode.

The incoming Fiber cable from Service provider for the Campus Broadband connectivity shall be terminated in the Server room. The laying and termination of Fiber optic cable within the campus will be provided.

The Rack Panel comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans-receivers, Fiber patch cord etc. of individual buildings/Blocks/ floors.

LAN Infrastructure at different Floors of various building shall be used commonly for IPABX, CCTV etc. along with LAN.

Brick masonry manholes with covers shall be provided at suitable lengths to facilitate easy wire/cable pulling.

Wireless access points for Wi-Fi connectivity are proposed in Administrative, Faculty etc. All types hospital facility areas shall have only Wi-Fi connectivity whereas other buildings in the complex shall be with wired data outlets along with the Wi-Fi connectivity.

Pure IP at Core Server Based PBX System

Contractor has to provide RJ-45 Telephone socket outlets with suitable IP Phones instruments in all blocks/ buildings at convenient locations, as required. CAT-6A wiring shall be provided in recessed/surface conduits/ raceways from each telephone point up to the Rack panel (Patch Panel & Switch) at each floor or nearest Rack Panel of all buildings /Blocks. The Maximum length of the CAT-6A cable shall be 90 M.

The scope of work shall include planning, designing, supply, installation, testing and commissioning of complete of IP based voice communication system with 02 no. PRI Trunks lines (30 channels) with clip facility for minimum 750 IP users license for life time. The outlets are as described in the Internal EI subhead. The scope of work also includes the provision of the IP based telephones.

The wiring shall be in the scope of the work of the firm and shall be IP based LAN networking, as described in the Internal EI subhead. LAN networking shall be covered in the LAN subhead. The complete system has to be supplied, installed, tested and commissioned in complete manner to have a fully functional system, as required.

The Scope and purpose are to provide the voice communication with latest Pure IP at core Server based Voice communication system in (1+1) H.A mode to all the users within the campus including IP based operator console, In-skin Voice mail for all the users & access to call outside the campus through analog trunks or PRI trunks via local service provider (e.g MTNL/ BSNL etc.).

The Scope and purpose are to provide the internal as well as external voice communication for all the users in entire campus. The architecture of the system should be IP at Core (Server based solution). The system should have minimum 8 port in-skin voice mail used to play the welcome message during the incoming call through the analog or PRI trunk.

Voicemail will be used to leave the voice message in user's voicemail box. Like, if user doesn't answer the call. Then caller will get the guided message to leave the voice message for the user. The user will get visual indication in the analog phone he will know that there is some message in his voicemail box & he will retrieve the message by dialing a code followed by his PIN.

The hardware& software required for the system including Servers, gateways, workstations, IP based Operator console, 19" rack, online UPS, Access switches, gateways for analog as well as PRI trunks will be in EPC Contractor scope.

It will be the responsibility of the vendor/bidder to make the entire system fully functional as per the specifications. Vendor/ bidder shall consider any equipment/devices required to make the system functional if not mentioned herewith.

The project is on design and build basis and must cover the entire campus and building. Every individual staff should have telephone facility to communicate within the campus & outside the campus.

IPABX with minimum capacity of 750 Telephones & expandable up to 1000 telephones shall be located at Server Room in the Administrative block. The PRI lines for IPABX shall be terminated in the separate Rack in server room of Administrative Block. This Rack will be connected to the IPABX system.

The Rack Panel (comprising of jack/Patch panels, Network switches, patch cords, power supply units, Cooling Fans, Wire managers, LIUs, Trans receivers, Fibre patch cord etc.) of individual buildings/Blocks shall be connected to the main IPABX Server Rack with optical Fibre cables to be laid underground in DWC HDPE Pipe of suitable size.

Manholes with covers shall be provided in the underground DWC HDPE pipes at suitable lengths for easy pulling & maintenance of cables.

Technical Specification of Structured Cabling

Technical Specification for Structured Cable and Components:	
1	**06 Core Fiber Cable (OFC)**
	The fiber should be optimized for operation at 1310 nm and at 1550 nm.
	Should fulfill the requirements of ISO.IEC 11801 - 2nd Edition, type OS2, ITU-T REC G 652D spec IEC 60794-1-2 F5
	No of Cores : 6
	Max. Attenuation: At 1310 nm <= 0.40 dB/km, At 1550 nm <=0.30 dB/km
	Fibre/Tube Identification : Single Tube
	Fibre protection (Tubes) : Polybutylene Terephthalate (PBT)
	Armouring : CST
	Thickness : 1.6mm
	Outer Sheath :UV Stabilised Polyethylene (PE)
	Central Strength Member: Steel wire coated with PE
	Water Blocking : Thixotropic Gel (Tube); Petroleum Jelly (Interstices)
	Cable Diameter (D) : 9.0 ± 0.5 mm
	Mass (Nominal) : 91 kg/km

Technical Specification for Structured Cable and Components:	
	Min. Bending Radius (during Installation) : 20 D;D-Outer Diameter
	Max. Tensile Strength-Short Term : 1500N
	Max. Crush Resistance-Short Term : 2200N/100 mm
	Operating Temperature range : -40°C to +70°C
2	**LC Type 9/125µm OS2 Fiber Optic Simplex Pigtail**
	Type : 9/125 micron fibre performance
	Jacket Material : LSZH complying to IEC 61034-1 & 2,IEC-60332-1, IEC-60754-1 & 2
	Operating Temperature: -40°C to +75°C
	Connector Insertion Loss: 0.30dB(Max)
	Attenuation: 1310/1550 : 0.36/0.22 dB/KM
3	**Patch Cord, LC, Duplex, SM, G657A2, PC, LSZH**
	Cable : LC-LC 9/125µm OS2 Single mode Duplex Patch Cord Length : 3mtrs
	Connectors: The optical fiber patch leads shall comprise of Single mode 9/125µm fiber with 2XLC type fiber connectors terminated at each end of fiber patch cord.
	Insertion loss should be better than 0.35 dB
	Jacket Material : LSZH complying to IEC 61034-1 & 2,IEC-60332-1, IEC-60754-1 & 2
	Attenuation: 1310/1550 : 0.36/0.22 dB/KM
	Connector Loss : 0.30dB(max)
	Operating Temperature : -40°C to +75°C
4	**Fiber Optic LIU Rack Mount LIU (12/24 Ports)**
	Fiber optic patch panel: Fiber optic patch panel FMS Termination Drawer should have sufficient slots to accommodate 3 of 12/16 Port LC Adaptor Plates.
	Should have Slide type drawer structure
	Height: 1 U, 1.75 inches (12 & 24 Ports)
	Material: Cold Rolled Steel in surface coated by electrostatic epoxy powder

Technical Specification for Structured Cable and Components:	
	Slots: FMS should have sufficient slots to accommodate adaptor plates
	Empty Slots of FMS should be covered with blank plates.
	Splice Tray: Splice Tray of ABS, Comply with UL 94V2 material should be supplied with LIU.
5	**12/16 Port LC/SC Type Adaptor Plates (Single mode)**
	The adaptor plate should be pre-loaded with LC/SC Type Single mode Duplex Adaptors.
	Port Density :12/16 LC/SC Single mode Ports
	All LC adapters should be duplex type with shutter for protection. Adapters should be snap mount for easy insertion and removal.
	Insertion Loss: <0.2 to <0.1 dB
	Compliance :RoHS Compliant
6	**Cat 6A UTP Cable**
	4 Pair Cable with integral cross -member pair separator for uniform characteristic impedance.
	Category 6A Unscreened Twisted 4 Pair 100 Ω cable shall be compliant with ANSI/TIA/EIA-568-C.2; ISO/IEC 11801 Ed. 2.0; 10BASE-T, IEEE 802.3 af (PoE), 100BASE-T, IEEE 802.3at (PoE+) & 1000BASE-T
	Category 6A UFTP cables shall extend between the work area location and its associated telecommunications closet and consist of 4 pair. ISO/IEC 60332-1-2; IEC 60754-1 & 2; IEC 61034-2
	Conductor: Solid Copper
	Conductor Diameter: 0.56mm (23 AWG)
	Insulator HD Polyethylene solid
	Jacket: FR LSZH RoHS complied
	Outer Diameter: 7.4± 0.4mm
	Max Temperature: -20°C to +75°C
	Mechanical Test

Technical Specification for Structured Cable and Components:	
	Should have Pulling force of 100N.
	Bend Radius: Installation: <4 X Cable Diameter,
	Electrical Test
	D.C. resistance conductor : <9.38Ω /100m
	Resistance Unbalance 5% Max
	Mutual Capacitance : < 5.6nF/100m
	Capacitance Unbalance : < 330/100m at 1Khz
	NVP : 76%
	Operating Temperature: -35Deg C ~ +65 Deg C
	ETL 4 port channel Test report should be submitted with 800 Mhz
	Should be ETL Certified
7	**Cat 6A STP RJ 45 Keystone Jack**
	RJ45 Jack of Category 6A, for the establishing of transmission channels of class EA with up to 4 plugged connections, complies with Category 6A requirements of the standards ISO/IEC 11801:2.1 edition, EN 50173-1 (200X), ANSI/TIA/EIA 568-C.2, backwards compatible with Cat6, Cat.5e and Cat.5.
	Suitable for 10GBase-T applications in acc. with IEEE 802.3an more than or equal to 800 MHz (ETL test report to be submitted)
	Compatible with RJ standard plugs (RJ11, RJ12, RJ45), PCB- and tool free based connection of installation cables AWG 24 – 22 (0.5 mm – 0.65 mm) and flexible cables AWG 26/7 – AWG 22/7.
	IDC termination should feature nil crossover in acc. with EIA/TIA 568-A/B, Tin phosphor bronze contacts for complying IEC 60603-7
	Housing material: Polycarbonate (UL-94-V0)
	Jack Contacts: Phosphor bronze, 50 micro-inch gold plating over nickel
	Contact Force: 99.2g (3.5oz) FCC Plug
	Dielectric Withstand Volt: 100VAC RMS 60Hz
	Contact Resistance: <= 20 mΩ

Technical Specification for Structured Cable and Components:	
	Current Rating: 1.5A at 68°F
	Plug insertion Life: >=750 times plug in
	Plug Retention Force:30lb (133n/13.3Kg)
	Temperature Test: -10°C to 60°C (14°F to 140°F)
	Keystone should feature with Tool free termination technology
	Material: RoHS complied
	Should be be 3P Certified for 4 pair Poser over Ethernet under electrical load of up to 2A per conductor
8	**Patch Cord, STP/UTP 4P, Cat.6A, length 1.0/ 2.0 m**
	Standardization: Compliant with Cat.6A, Class EA requirements: ISO/IEC 11801 2.1 Edition Compliant with Cat.6A component
	Cable shield: STP/UTP
	Number of conductors : 8
	Stranding: 7 x 0.16 mm (26 AWG)
	Cable jacket characteristics: cable, metal-free
	Cable overall diameter: 6.0±0.2 mm
	Tube / Wire type: stranded conductor
	Insulation: foam skin, polyolefin, 0.98±0.02mm OD.
	Plug: Feature cable retention, with enhanced pull strength.
	Cat 6A patch cord plug to have round cable holder and strain relief boot to avoid bending.
	plug should have high repeatability cross talk performance
	Plug design should be patented with unique feature
	Should be ETL certified
9	**19" 1U 24 port sheilded Patch Panel**
	Patch panel should be modular design, populates up to 24 UTP/STP keystone-type jacks in 1U

Technical Specification for Structured Cable and Components:	
	Patch panel should be Enhanced with cable strain relief with retention tray; It should be single metal both front panel and rear tray
	Material: sub-rack made of Aluminum with dimension 44.4 mm : 482.6 mm : 105 mm (h:w:d) tray
	Information Outlet or connectin module should comply with the specification mentioned above in 2
	Panel should be supplied with earthing wire and earther lug for STP
	Standard : Conforms to IEC-60603-7 (603-7) for keystone-type, snap-on apertures
	Should be RoHS complied
10	**Faceplate**
	Should be UK style Keystone-type Faceplates are available in 1, 2 & 4 port configurations
	Should be featured with shutter options
	Should support Work with both Flush and Wall mount box
	Should support Operating Temperature: -10～+60; Storage Temperature: -40～+68; Humidity: 10%~90% RH
	Material: ABS, UL 94V-0; Spring: SUS304; Surface Finish: Polished
11	**Cat6A Shielded Field Termination Plug**
	Standardization: Compliant with Cat.6A, Class EA requirements: ISO/IEC 11801 2nd Edition backward Compliant with Cat.6 component standards IEC 60603-7-4 and 60603-7-5
	Cable: UTP/STP
	Number of conductors : 8
	Termination: IDC type Tool less
	RJ45 Plug Metal covers: Zinc die-casting with nickel plated
	RJ45 Plug contacts: Phosphor bronze with nickel plated
	Plastic Wire Organizer: PC, Color: White, UL 94V-0
	IDC Durability: ≥20 Termination cycles

Technical Specification for Structured Cable and Components:	
	RJ45 Jack Durability: ≥750 Plug-Jack mating cycles per IEC 60603-7-81
	Operating Temperature: -10 degree C to +60 degree C
	Patch Cord retention strength: 7.7 Kg Max. according to IEC 60603-7-5
	Rj45 Plug Insertion force: 3.1 Kg Max according to IEC 60603-7-81
12	**Slim Patch Cord, STP 4P, 30 AWG, Cat.6A, length 1.0/ 2.0 m**
	Standardization: ANSI/TIA-568-2.D Conform to ANSI/TIA-568-C.2, ISO/IEC 11801 2.1 edition and CENELEC EN50173 (2007) for Category 6A/CLASS EA standards
	Cable shield: STP/UTP
	Number of conductors : 8
	Polyester Aluminum foil on each pair along with Braid shield
	Gold-Plated Copper Contacts Provide Corrosion Resistance and Signal Conductivity
	Basic Wires: Conductor: Eight wires stranded bare copper, 7 x 0.10mm (30 AWG). Insulation: foam skin, polyolefin, 0.68±0.02mm OD.
	Shield: Overall Braid Shield
	Overall Diameter: 4.5 ± 0.2 mm max..
	Outer Sheath: LSZH – IEC-60332-1
	Electrical: DC Resistance: Max. 376 Ω/km at 20°C Resistance Unbalance: 2% max. at 20°C Mutual Capacitance: 43 pF/m nominal at 1 KHz Voltage Rating: 30 V rms Dielectric Strength: 500 VAC/one minute mean (wire to wire) Dielectric Withstanding: 1000 volts RMS, 1 min. (60Hz) Insulation Resistance: 500 mega-Ohms Current/Voltage Rating: 1.5 Amps, 30 VAC / 56 VDC
	Storage & Operating Temperature: -20°C to 60°C & -10°C to 50°C
	Plug Housing: PC Resin UL-94V2
	Contacts: High grade copper alloy
	Plating: 50 micro-inch (1.27 micro-meter) gold

Technical Specification for Structured Cable and Components:	
	ETL Verified Certificate for 2 port Channel

Technical Specification of IP-PBX System

S.No.	**Description**
1	**IP Telephony System Architecture**
	The IP telephony system must be based on a pure IP technology that is a software-only solution.
	The IP telephony system must support unified communication (UC) server & gateways architecture for SIP, Digital and Analog trunks connectivity.
	The System must be TEC Approved with GR Number.
	The system must be capable of supporting Analog, Digital, IP Telephones, and SIP based video desk phones.
	The communication servers must work in an Active/Active redundancy mode. It should be possible to define servers load balancing mode.
	All servers must be provided in a cluster mode. If one cluster server fails, one of the other cluster servers in the network must be able to take the complete load of the calls automatically (without any manual intervention) and without dropping any existing calls (IP,TDM & PRI) or data (CDR, CTI). Management of all servers in cluster should be from same web page. All servers should have same database.
	The telephony system must be able to register SIP phones/SIP video phones and MGCP phones directly to it
	System should have Distributed Architecture
	It should be possible to install Telephony system in VMware EXSi 5.5 or higher.
	All Data (Numbers, COS, Routing, Applications) should reside in all the Servers
	Database replication in All servers should be automatic and real time
	Should support Remote Survival Nodes
	In case of failure of one server, the SIP Phones, SIP Gateways, MGCP Phones should register with second Server automatically

S.No.	Description
	System Diagnostics should be done in Server
	Hot Standby for SIP Phones and Gateways i.e SIP Phones and Gateways should register automatically to next available telephony server.
	COTS - commercial off-the-shelf Servers should be used for telephony system
	Telephony system should use Linux Operating System
	system should support CSTA phase III Protocol
	Full continuation for call signalling and media must be supported
	Calls must not be disconnected and control must remain throughout the swap to an alternate server including full call control (transfer, conference actions,continuation of CDR data for the existing call).
	Load Balancing of end points must be possible by the administrator
	There must be no restriction on the number of endpoints being backed up in case of one server failure.
	UC platform servers must provide full failover and redundancy
	System should support the following SIP RFCs:
	RFC 3261 (SIP: Session Initiation Protocol)
	RFC 3262 (Reliability of Provisional Responses in Session Initiation Protocol)
	RFC 3263 (Locating SIP Servers)
	RFC 3264 (An Offer/Answer Model with Session Description Protocol (SDP))
	RFC 3265 (Specific Event Notification)
	RFC 2327 (SDP- Session Description Protocol)
	RFC 1889 and 1890 (RTP/RTCP)
	RFC 3515 (REFER)
	RFC 2833 (DTMF over IP)
	Scalability
	It should be possible to add more sites and users without the need to change the software and existing configuration.
	The system must be scalable to at least 1500 endpoints in a single cluster architecture.

S.No.	Description
	Each server must support a minimum of 1000 endpoints
	The call signalling server must handle traffic at a minimum of 100K BHCC.
	The system must be modular, scalable and distributable
	System Survivability
	The UC platform must consist of one or many servers where each server in the cluster provides complete 100% application functionality.
	In case of a failed server, all endpoints registered with that server need to register instantly with a different server in the cluster with no interruption to on-going calls.
	Media Gateways must have survival mechanisms that allow them to maintain 100% of the telephony services for their users in case of failure in the WAN links when the signalling with the call server drops.
	The life cycle of the entire system being provided must be at least Ten (10) years.
	The system gateway must be able to restart automatically without human intervention when the external AC power supply is resumed after complete power failure (even after the batteries are discharged).
	The telephony system must be capable of providing 99.999% availability.
	Distributed Architecture
	The UC platform must have distributed architecture and centralized control for all the sites in the network.
	The proposed solution must support Hybrid cloud solution in order to guarantee business continuity with overall survivability regardless of a failure at any single location.
	The proposed solution must enable part of the cluster to be hosted in a Cloud Service Provider (CSP) to run all applications.
	The proposed solution must have built in redundancy using a cloud solution to provide automatic disaster recovery option.
	The proposed solution should have provision to be installed using an image of the application an easily implemented on the Cloud Service Provider servers.
	Quality of Service (QOS)
	The voice and signaling frames must be marked [tagged] in order to be recognized.
	Server – Physical Attributes

S.No.	Description
	COTS – Commercial Off-the-Shelf servers must be used.
	The redundant server must have separate hardware, not sharing elements like hard drives and RAM etc., to avoid a single point of failure.
	The server should have AC power supply.
	The system must be based on server gateway architecture with external appliance servers
	No card based processor systems / soft switch should be quoted.
	The call processor must run on Linux OS.
	Minimum Server Specifications:
	The CPU must be from the Intel® Xeon® processor E3-1220v5 or latest
	The server must have at least 8GB RAM
	The server must have Hard Drives (300GB each) of storage
	The server must have a Dual 1GB network interface.
	Form Factor for physical server (Not Virtual Machine) should be 1 U
	Gateways
	The media gateways shall be capable of being centrally managed via the telephony management application. The system should support multiple gateways.
	The system gateway should be able to restart automatically without human intervention when the external ac power supply is resumed after complete power failure
	The system gateways should support the following type of extensions:
	Analog
	Digital
	Cordless (DECT) Extension
	SIP
	MGCP
	The system gateway should support the following type of trunks :
	Analog: E&M (2W), E&M (4W), DC loop signaling, decadic, DTMF
	Digital: 2Mb stream with the following signaling protocols (Digital CEPT,

S.No.	Description
	R2MFC)
	Standard ISDN BRI, PRI
	SIP and MGCP on VOIP
	ISDN (30B+D / 23B+D / 2B+D)
	SS7
	ISDN QSIG (30B+D / 2B+D)
	Q-sig over IP
	Security
	Administration of the system should be using HTTPS
	It should support the Interop with leading SBC
	System should use TLS (Transport Layer protocol) to encrypt SIP, HTTP, FTP and SRTP (Secure Real-time Transport Protocol) and SRTCP to encrypt RTP and RTCP
	System should have auto Provisioning profiles contain pre-configured sets of features that must automatically polls and updates registered phones with the latest phone firmware and configuration files.
	Mobility
	The system should have Call Back feature. If the user dials his own extension from predefined number (mobile/landline) then system should disconnect the call and then system should call the user to provide the dial tone so that user can make intercom or PSTN calls.
	The system should have Call Through feature. If the user dials his own extension from predefined number then system should provide dialtone to make intercom or o/g calls.
	The system should have Flexi Call (Forking, reach-me-anywhere) feature. Users should be able to receive calls on any of their phones, from almost anywhere. An incoming call rings on all or specific phones until the user answers the call. The user can transfer the call, establish a conference, and so on, whether the answering device is an internal device, an external phone, or a cellular handset. If the answering phone is an external device, the call automatically becomes an authorized mobility call.
	The system should support SIP Client on smart phone.
	SIP Endpoints

S.No.	Description
	All SIP phones must support the standard SIP protocol. No proprietary protocols are allowed to be used.
	SIP phones must support the configuration of programmable buttons with functions such as Break-in, Conference call, Deflect, silent monitoring and more.
	SIP phones must work in conjugation with the following applications:
	1. Contact Centre (Agents Phones)
	2. Attendant Console
	3. Managed Audio Conferencing
	4. Managed Video Conferencing
	5. UC clients
	ACD
	System should have built in Automatic Call Distribution (ACD) with following features:
	Busy ACD Group announcement
	Hunt Group Release
	IVR-ACD
	Log In / Log Out
	Multiple Announcements:
	1. Mandatory announcement - All incoming callers to an ACD/HUNT group must be able to hear an introductory announcement in its entirety usually explaining about the company, product, or campaign.
	2. First announcement - If all agents are busy, callers must be able to hear this announcement once usually informing them that their call has been placed in queue. (The system must be able to cut short this announcement if an agent \becomes available to attend to the caller.)
	3. Music - If no agents are available after the first announcement (or no First and Periodic announcers have been configured), the caller must be able to hear background music while in queue.
	4.Periodic announcement - Alternating with background music, these announcements can also be played to callers in queue according to the Periodic Announcement Interval (see above) until the ACD/HUNT call is answered.

S.No.	Description
	Release / Resume
	Wait Queue
	Wrap-Up Time
	Automatic Release of ACD Agent
	Automatic Call Distribution (ACD) Extended Overflow
	Zone Page
	A phone user must be able to simultaneously broadcast a message over all types of endpoints.
	The maximum quantity of endpoints in one zone should not be less than 100.
	System Administration
	System administration should be web based.
	All programming of system should be done through a web-based GUI interface.
	The administrator should have Dynamic Profiles.
	The system should allow for complete multi-level administration. The administrator must be able to define at least five (5) different administration level profiles that can be applied to allow subsets of users to access and manage particular pages in the systems Web Portal
	Certification Requirements
	1. The OEM must comply with ISO 9001 certification in all the company's activities.
	2.The products must comply with Safety and EMC standards, including FCC, UL/TUV, CE, and the RoHS directive.
	System Features
	ANI (Caller ID) Restriction
	ARS (Automatic Route Selection)
	Auto Attendant
	Call Forward at Night/Holiday
	Call Forward Destinations
	Call Forward for Undefined Stations
	Call Forward on Busy

S.No.	Description
	Call Forward on DND (Do Not Disturb)
	Call Forward on Logout
	Call Forward on No Answer
	Caller id based routing for individual extension
	Deflect (Divert) Call
	Digit Train Conversion
	Direct-In-Dial
	Direct-In-Line (DIL)
	Hot Line
	Interactive Voice Response (IVR)
	Least Cost Routing
	Look Ahead Routing (LAR)
	Numbering Plan
	Personal Routing Rules based on caller id and DNIS
	Predetermined Night Answer
	Toll Restriction – Digit Analysis
	Toll Restriction – Trunk Groups
	Trunk to Trunk Connection
	Trunk Transfer Restriction
	Classes of Service
	Night Answer Central Bell / UNA Pickup
	Page Queue
	Recall
	Recall / Incomplete Destination
	Second Ring back Tone
	Speed Dial Public (System) and Private
	Virtual Numbers
	Music On Hold

S.No.	Description
	Voice Page
	Silent Monitor
	Zone Page
	Barge In
	Wake up
	Extension Features
	Answer Call Waiting by Transfer
	Auto Set Relocate
	Auto-Answer
	Automatic Disconnect
	Automatic Number Identification (ANI) Display
	Browse Personal Directory
	Busy Lamp Field
	Call Forward All
	Call Hold
	Call Log
	Call Parking and Call Pickup
	Call Waiting
	Caller ID Control
	Caller-ID Screening
	Caller id based routing for individual extension
	Calling Number and Name
	Camp-on Idle
	Configurable DSS Buttons
	Direct Dial without Off Hook (Hands Free)
	Directed Call Pickup
	Display Automatic Number Identification (ANI)
	Display Dialed Number and Name

S.No.	Description
	Display Dynamic Call Divert Information
	Display Select Hold Display
	Display Time/Date Function
	Do Not Disturb (DND)
	DSS/BLF
	Elapsed Time Display
	Group Call Pickup
	Hands Free
	Hands-Free Announce and Reply (Idle State)
	Last Number Redial
	Login and Logout
	Message Waiting Indication
	Multi Appearance (Call Waiting)
	Multiple Line Appearance
	On-Hook Dialing
	Placing Multiple Calls on Hold
	Privacy – ANI Restriction
	Reminder/wake up Call
	Restrictions – Station
	System Non-Exclusive Hold
	Transfer with Consultation
	Transfer without Consultation (Blind)
	Voice Page
	Emergency Preemption
	Listen to Paging while in a call (Busy Condition)
	ULA - User Line Appearance (ULA)
2	**Emergency communication**
	The Emergency communication resource should be from the same telephony

S.No.	Description
	server and have the facility to automatic dial out to connect up to 100 participants in a single conference. System should also have 100 party managed meet me conference. It should be possible to further divide 100 party conference bridge into any combination like 10 X 10 party, 5 x 20 party etc. if required. The meet me conference should be secured means to enter to the conference bridge, the user should enter the password.
	The emergency communication management should be from Web Browser/HTML5 based GUI based interface from Windows PC and Touchscreen Devices.
	The emergency communication must be controlled by a user defined as Group Operator from the web based GUI.
	The Group Operator should have following features as below:
	1. The Group Operator must be able to add / remove members
	2. The Group Operator must be able to add other conference members
	3. The Group Operator must be able to mute / unmute (User, None, All)
	4. The Group Operator must be able to lock / unlock the conference
	5. The Group Operator must be able to close the conference
	6. It must be possible to dial out a pre-defined group (or multi-groups) of participants/numbers by simply pressing the pre-assigned virtual key on PC.
	7. Each pre-set conference must have its own unique dial number such that when this group number is dialed; all the number stations will ring simultaneously.
	8. Any combination of stations and external numbers must be able to be defined as members of the Group Call.
	9. Participants may join a conference in the audible or in the mute mode, if in mute mode, the right to speak must be selectively offered to attendees per their request by a special signal sent to the Group Operator by the attendees.
	10. Attendees must be able to be added or excluded at any time by the Group Operator
	11. The conference must be terminated when the Group Operator leaves (auto terminate if all members left are muted).
	12. The Group Operator must be able to barge into an existing user call based on pre-emption predefined rules.
	13. Group operator must have two SIP phones so that if one phone is busy in conference, the second phone can be used to add participants.

S.No.	Description
	14. Both group operator SIP phones should be controlled by web based conference management GUI for telephony feature like answer, hold, transfer etc.
	15. The same Group operator should also function as operator console
3	**Help desk specification**
	1.1 General capabilities
	1.1.1 The proposed solution must be embedded within the platform, not installed on a separate server and should be from the same OEM of the telephony system.
	1.1.2 The system must be an All in one solution that provides a one server solution for UC&C and 5 agent license for help desk.
	1.1.3 Single server deployment with intuitive and central management capabilities should support true multimedia.
	1.1.4 Help desk managers must be able to easily prioritize customers and incoming contacts regardless of the media used.
	1.1.5 The same set of business and routing rules can be applied to voice / chat calls, emails, and faxes if required.
	1.1.6 The help desk must support multi-layer routing including Priority, Skill Based, Statistical, Business Rules, and Customer Defined Values.
	1.1.7 Help desk must have embedded IVR, enabling managers to design routing plans and accurately assess help desk activity trends.
	1.1.8 The IVR application must be a GUI application that can be managed by the customer.
	1.1.9 The customer must have the ability to build new self-services applications like new IVR flow for new service.
	1.1.10 Customer must have the ability to define/change routing rules by himself based on customer's profile.
	1.1.11 The help desk must support Outbound, Call-back and Campaigns – including preview, progressive and automated outbound dialing.
	1.1.12 The supervisor must be able to see the status of help desk agents in real-time in his PC like logout, busy, free, release, non ACD etc. in graphical form in pie chart / bar chart.
	1.2 Help desk facilities
	1.2.1 Real-time Monitoring – must provide supervisors with statistical

S.No.	Description
	information about the current status of the help desk with on line refresh (1sec). The application must include pre-defined list of reports and the customer (end user) should be able to choose reports as needed.
	1.2.2 The Real Time application must provide the ability to build/change the workspace for each user and by user (not vendor or distributor).
	1.2.3 The RT must provide the ability to move agents to/from different groups / queues for current login only.
	1.2.4 Historical Reports – must be able to collect all information from call entry to call termination. Call profile details for internal investigation purposes should be part of the contact center solution.
	1.2.5 The help desk solution must have an embedded Management Information System (MIS) suite that monitors all help desk activities, generating reports that summarize the past performance of the system over a given time period, and providing statistical analysis of the help desk within a specified period. Real-time and historical reports provide:
	Help desk agent should be able to do following activities from agent application installed on PC:
	Login/Logout from group
	Release/Resume
	Ready
	Wrap-up Code
	Release for Break
	Release for Meeting
	Control Wrap Up
	Supervisor Help
	Agent Board
	Answer
	Hold
	Retrieve
	Hang Up
4	**Specifications for Self Survivable Gateway:**

S.No.	Description
	Gateway should have minimum 96 analog/CO ports. Gateway should be from the same OEM of IP telephony system
	Voice Processing – voice codecs: G.711, G.729A, G.723.1,etc. and echo cancellation: G.168 with 64ms echo tail; dynamic jitter buffer; voice activity detector (VAD)
	Call Handling – configurable dialing plan
	Fax Processing – T.30, T.38 fax relay
	User Features – caller ID, call forward, call transfer, hotline, CRBT, do not disturb, speed dialing
	Protocol – SIP (RFC3261, MGCP etc)
	Standards – caller ID detection (FSK)
	Primary and Backup – the gateway can be configured and controlled in server clusters
	LED indicators– power, system status, network status, line status
	Ethernet Connector – Dual Gigabit Ethernet. The Gateway should function as a Self-Survivable unit when the Ethernet connectivity at gateway end breaks.
	Power Input – -48 VDC, should have dual DC power supply or dual AC power supply
	Operation Humidity – 10% to 90% (non-condensing)
	Operation Temperature – 0 to 40ºC
5	**PRI Gateway specification**
	PRI gateway should have Configuration – 1 PRI (30 Channels) or 2 PRI (60 Channels) and should be from the same OEM of telephony system.
	Voice Processing – G.711, G.729A, G.723.1, GSM, iLBC;echo cancellation: G.168 with 64ms echo tail; dynamic jitter buffer; VAD and CNG
	Calling Control – called/calling party number translation; second stage dialing; voice detection; auto dialing with DTMF; ring back tone generation and detection; voice announcement
	Voice Proxy – RTP voice proxy function for NAT/firewall traversal
	Fax Relay – T.30 transparent mode, T.38 fax relay
	Call Handling – configurable dialing plan, up to 500 routing rules

S.No.	Description
	Configuration Interface – Web Utility
	Remote Management – Telnet, HTTP, TR069
	PSTN – ISDN PRI standard: ANSI, NI-2, DMS, 5ESS
	SIP – RFC3261, RFC2976, RFC3515, RFC3581
	DTMF – tone detection generation and detection; DTMF relay: RFC2833, INFO (SIP)
	DTMF detection and progress tone detection
	Play ring-back tone
	T.30 and T.38
	RTP proxy for NAT traversal
	Ethernet – RJ-45, 10/100 Base-T
	Trunking Interface – RJ-45
	System Memory – 128MB or higher
	System Flash – 16MB or higher
	Power Input – 220V AC or - 48 VDC , should have dual AC/DC power supply
	Operation Humidity – 10% to 90% (non-condensing)
	Operation Temperature – 0 to 40ºC
6	**Specification of Soft client**
	The soft client should be from the same OEM of IP telephony system. Wifi facility for smart phone to be provided by the customer.
	Soft client should be available for Windows PC, Android Phone and IOS phone
	It should support Windows 7, Windows 8, Windows 10
	It should be freely downloadable from Google Play / Apple store
	It should support following features:
	Make a call
	Hold
	Retrieve
	Transfer

S.No.	Description
	"Presences (User Select) -
	Change status: Available, Busy No Answer, Busy call waiting, DND, Logoff, Forward to VM "
	Dial users number - Internal, External, Mobile
	"Instant messaging - IM with another soft client User, IM with a Multi Destination, Search on IM sessions, Save IM sessions, IM to groups"
	3 way audio conference
	Call divert
	Camp on
	View missed call
	Contacts synchronized with the PBX directory

Technical Specification of Core Switch

Item	Technical Specifications
Type	Modular Switch with at least 6 service slots other than control card slots
Ports	24 ports (SFP+) with 10 Gbps speed provided on the dedicated card polutated with 16 nos. of 10G single mode SFP modules.
	12 x 10/100/1000 BaseT RJ 45 ports provided on the dedicated card (separate from 10G card).
	04 x 40G SFP ports distributed across the cards to have redundancy populated with 04 nos. of 40G single mode QSFP modules.
Switching capacity	Aggregate capacity of 6 Tbps or more and performance of minimum of 4 Bpps
Per slot bandwidth	480 Gbps full duplex
Architecture	The Switch should have a Truly Distributed Architecture. All Interface Modules should have all the resources for switching and Routing and should offer True Local Processing.
	The chassis should be ready with all fabric cards (max supported) to provide full throughput of the System from day 1.
	Redundant CPU, Redundant Switch Fabric and Redundant Power Supplies from Day 1

Item	Technical Specifications
	Fully decoupled control plane and data plane
	Support for 40G and 100G ports from Day 1
High Availability features	There should not be any single point of failure in the switch. All the main components like CPU module, switching fabric, power supplies and fans etc should be in redundant configuration. Components, like modules/power supplies/fan tray should be Hot Swappable
	Support for Hot Swap of all redundant components: Line Cards, Fabric, power supply, and fan trays
	Should Support software upgrades with minimal traffic disruption during the upgrade
	Switch should support processes to be run in protected memory space and independent of each other and the kernel, providing fault containment and enabling modular patching and upgrading and rapid restarting. Individual processes should be restarted independently without loss of state information and without affecting data forwarding.
Memory	16 GB DRAM
Layer 2 features	Should support Industry Standard Port/Link Aggregation for All Ports. Also Cross Module Link aggregation should be supported
	Jumbo Frames support up to 9K Bytes
	Should support port, subnet based 802.1Q VLANs. The switch should support 4,000 vlans
	The switch should support 512K MAC addresses.
	The switch should support IEEE 802.1w RSTP and IEEE 802.1s MSTP
Routing Protocols	Should support RIP v1/v2, OSPF v1/v2 from Day 1
	Should support BGPv4, IS-IS
	Should support IPv6 packet switching and routing using OSPFv3, RIPng in hardware from day 1.
	Should support minimum 512K Route entries for IPv4 and 512k for IPv6
Security features	Should support Access Control Lists
	Should support various type of ACLs like port based/vlan based.
	Should support integrated security features like DHCP relay with option-82, Dynamic Arp Inspection

Item	Technical Specifications
	Should Support MAC Address Filtering based on source and destination address
	Should have support for RADIUS and TACACS+
	The switch should support Port-security.
Network protocols	Should Support VRRP Protocol or equivalent from Day 1
	Should support MPLS. In case these features are nor supported in the chassis, vendor need to propose the equivalent functionality on separate device to ensure compliance and interoperability
	The Switch should support GRE tunneling protocol
Traffic policing	Should support Ingress/Egress Queuing
	Should be able to filter, mark and limit traffic flows
	Should support minimum 8 queues per port
	Should support policy based traffic classification based on Type of Service (ToS), IP Precedence mapping, Layer 2/3/4 defined traffic flows, MAC address, VLANs
Multicast	Should support H/W based IPv4 and IPv6 Multicasting
	Should Support IGMP v1, v2 , v3, IGMP Snooping
	Should support 128K IPv4/IPv6 multicast routes
	Should support Protocol Independent Multicast - Sparse Mode and PIM - SSM, MSDP
Network monitoring /management	Switch should be manageable through NMS on per port/switch basis with common interface for all manageable devices on the network. Should Support SNMP, RMON/RMON-II, SSH, telnet, web management through network management software.
	Should support port mirroring feature for monitoring network traffic.
	The switch should support role based access control to limit access to switch operations.
	Should have modular OS and should support configuration roll back to recover mis-configured switch to last known good configuration
IEEE Standards	IEEE 802.1AB
	IEEE 802.1D

Item	Technical Specifications
	IEEE 802.1p
	IEEE 802.1Q
	IEEE 802.1s
	IEEE 802.1w
	IEEE 802.3ae
	IEEE 802.3ba
	IEEE 802.3ah
	IEEE 802.3ad
Certification	EAL3/ NDPP or above Certified

Technical Specification of Access PoE Switch

S. No.	Detailed Technical Specifications
1	Minimum 24 x 10/100/1000 Base-T PoE+ and 4 x 1/10G ports. (with required transceiver modules)
2	1 U Rack mountable and should provide stacking of maximum 5 switches with 128Gbps of dedicated stacking/ equivalent bandwidth (All the stacking accessories should be included from day 1).
3	The Switch should have 2GB DRAM and 2GB internal Flash
4	256 Gbps or higher Backplane capacity and minimum 190 Mpps of forwarding rate
5	Should support Non-blocking hardware architecture
6	All interfaces should provide wire speed forwarding for both Fiber and copper modules
7	Support for at least 1000 VLANs & 32k MAC address
8	It should support IGMP snooping v1,v2 & v3
9	It should have static IP routing from Day 1 and should be upgradable to support OSPF and PIM
10	Switch should support 8 hardware queues per port
11	Dynamic Host Configuration Protocol (DHCP) snooping
12	Switch should support LLDP capabilities
13	Should support IP Source Guard , DAI and IPv6 Security feature like IPv6 RA Guard and IPv6 Neighbor Discovery Inspection

S. No.	Detailed Technical Specifications
14	Should support Secure Shell (SSH) Protocol and Simple Network Management Protocol Version 3 (SNMPv3).
15	Switch needs to have console port for administration & management
16	Management using CLI, GUI using Web interface should be supported
17	FTP/TFTP for upgrading the operating System
18	The Switch should support MACSec
19	Should support Energy Efficient Ethernet
20	IEEE 802.1x support
21	IEEE 802.1D Spanning-Tree Protocol
22	IEEE 802.1p class-of-service (CoS) prioritization
23	IEEE 802.1Q VLAN
24	IEEE 802.3 10BASE-T specification
25	IEEE 802.3u 100BASE-TX specification
26	Switch should have internal redundant power supply and Hotswappable fans
27	Switch should able to support management via CLI, Web interface
28	SNMP v1,v2,v3
29	Switch should be manageable through both IPv4 & IPv6.
30	Switch should be UL-UL60950-1,FCC Part 15, VCCI Class A, EN 55022, EN 55024, EN 300386, CAN/CSA 22.2 No.60950-1, Reduction of Hazardous Substances (ROHS) certified
31	Switch should be IPv6 Logo Certified
32	Switch Should be Common Criteria NDPP/NDcPP certified

5.38. II ACTIVE ICT (ACCESS CONTROL, DISPLAY, IP BASED CCTV CAMERA & TELEPHONE)

Technical Specification of Dome Camera

S.No	Features	Specifications
1	Form Factor	DOME
2	Certification	UL,CE,FCC
3	Housing	IP67 and IK10 or better

S.No	Features	Specifications
4	System Compatibility	ONVIF profile S ,G & T
5	Max Resolution	4MP
6	lens	2.7mm to 12 mm motorized varifocal length
7	Focus	Auto focus
8	Image sensor	1/2.8" or larger
9	H-FOV	99 ~ 30°
10	Min illumination	0.01 Lux @ (F1.2,AGC ON), 0 Lux with IR
11	Shutter speed	1/5 s ~1 / 100,000 s
12	Video compression	H.265+ ,H.265 ,H.264+ H.264
13	Video bit rate	256 Kbps to 8 Mbps
14	Noise reduction	2D / 3D DNR
15	Video Streams	Quad stream , Each stream should support H.265+ compression
16	IP filter	Should support IP filter for security purpose
17	Frame rate	Main stream upto 5MP@25fps , sub stream upto 2MP@25fps , third and fourth stream upto VGA@25fps
18	ROI	Should Support ROI for Better bandwidth consumption
19	BLC	Support
20	Day & Night	IR cut filter with auto switch
21	Day / Night Switch	Auto / Schedule / Triggered by Alarm In
22	Edge analytics	Motion Detection, Perimeter Intrusion, Line Crossing, Stationary Object, Pedestrian detection, Face detection (deep learning) ,Cross counting
23	Image setting	Flip , Rotation , Corridor mode, Saturation, Brightness, Contrast, Hue, Sharpness adjustable
24	Rotate Mode	Yes

S.No	Features	Specifications
25	WDR	120 dB WDR
26	Alarm	1 input, 1 output
27	Audio	1 input, 1 output
28	SD Card support	upto 128 GB
29	Protocols	TCP/IP,HTTP,DHCP,DNS,DDNS,RTP/RTSP,PPPoE,SMTP,NTP,UPnP,SNMP,HTTPS,FTP,
30	Video output	1 X BNC
31	Reset button	Available
32	Security	Flash-prevention, dual stream, heartbeat, password protection, privacy mask, IP address filtering
33	Digital Zoom	Should have the capability to digitally zoomed in web browser by selecting the area using mouse
34	Factory Default	Should have the option of setting the configuration to factory default except network settings.
35	Privacy Zones	Min 4 Nos of selectable privacy Zones
36	User accounts	Should support 1 admin and 6 user accounts
37	Firmware upgrade	Firmware upgrade shall be done through web browser
38	Remote Update	Camera IP and firmware should be upgradable through the device search tool/Software without directly logging in to the camera. Firmware should also be upgradable through web browser
39	Defog	Should support Defog mode
40	IR Distance	Min IR distance 40 meters
41	Vandal resistant	IK10
42	Operating Temperature	-30°C ~ 60°C Humidity 95% or less (non-condensing)
43	General	OEM should not be blacklisted nationally or internationally

Technical Specification of Bullet Camera

S.No	Features	Specifications
1	Form Factor	Bullet
2	Certification	UL,CE,FCC
3	Housing	IP 67 and IK 10 or better
4	System Compatibility	ONVIF profile S , G & T
5	Max Resolution	4MP
6	lens	2.7mm to 12 mm motorized varifocal length
7	Focus	Auto focus
8	Image sensor	1/2.8" or larger
9	H-FOV	99 ~ 30°
10	Min illumination	0.01 Lux @ (F1.2,AGC ON), 0 Lux with IR
11	Shutter speed	1/5 s ~1 / 100,000 s
12	Video compression	H.265+ ,H.265 ,H.264+ H.264
13	Video bit rate	256 Kbps to 8 Mbps
14	Noise reduction	2D / 3D DNR
15	Video Streams	Quad stream , Each stream should support H.265+ compression
16	IP filter	Should support IP filter for security purpose
17	Frame rate	Main stream upto 5MP@25fps , sub stream upto 2MP@25fps , third and fourth stream upto VGA@25fps
18	ROI	Should Support ROI for Better bandwidth consumption
19	BLC	Support
20	Day & Night	IR cut filter with auto switch
21	Day / Night Switch	Auto / Schedule / Triggered by Alarm In
22	Edge analytics	Motion Detection, Perimeter Intrusion, Line Crossing, Stationary Object, Pedestrian detection, Face detection (deep learning) ,Cross counting

S.No	Features	Specifications
23	Image setting	Flip , Rotation , Corridor mode, Saturation, Brightness, Contrast, Hue, Sharpness adjustable
24	Rotate Mode	Yes
25	WDR	120 dB WDR
26	Alarm	1 input, 1 output
27	Audio	1 input, 1 output
28	SD Card support	upto 128 GB
29	Protocols	TCP/IP,HTTP,DHCP,DNS,DDNS,RTP/RTSP,PPPoE,SMTP,NTP,UPnP,SNMP,HTTPS,FTP,
30	Video output	1 X BNC
31	Reset button	Available
32	Security	Flash-prevention, dual stream, heartbeat, password protection, privacy mask, IP address filtering
33	Digital Zoom	Should have the capability to digitally zoomed in web browser by selecting the area using mouse
34	Factory Default	Should have the option of setting the configuration to factory default except network settings.
35	Privacy Zones	Min 4 Nos of selectable privacy Zones
36	User accounts	Should support 1 admin and 6 user accounts
37	Firmware upgrade	Firmware upgrade shall be done through web browser
38	Remote Update	Camera IP and firmware should be upgradable through the device search tool/Software without directly logging in to the camera. Firmware should also be upgradable through web browser
39	Defog	Should support Defog mode
40	IR Distance	Min IR distance 50 meters
41	Operating Temperature	-30°C ~ 60°C Humidity 95% or less (non-condensing)

Technical Specification of PTZ Camera

S.No	Features	Specifications
	Parameter	**Value**
a.	Camera Type	True Day/Night IP PTZ Camera
b.	CMOS	1/2.8"
c.	Resolution	2MPor better
d.	Frame Rate	25fps or better
e.	Min. Illumination (color)	0.2lux @ F1.6 or better
f.	Min. Illumination (B/W)	0.2 lux @ F1.6
g.	WDR (dB)	120dB
h.	Min. Pixels	1920x1080
i.	Triple Streams	Required, individually configurable streams at different frame rates
j.	Lens	6mm - 180mm or 4.3mm to 129mm or 4.5mm to 135mm
k.	Zoom Ratio	30x
l.	Image Enhancement	BLC, 3DNR, DEFOG
m.	Electronic Image Stabilization	Required
n.	Privacy Mask	Required
o.	IR Illumination	Internal or External required
p.	IR Range	150m or better
q.	Audio	Dual Channel
r.	Audio Protocols	G.711a/G.711u/AAC or equivalent
s.	SD Card Support	Upto 32GB
t.	Alarm Input	5 nos. required
u.	Alarm Output	2 nos. required
v.	Compression	H.264 & MJPEG
w.	PoE	Required

S.No	Features	Specifications
x.	Power	12VDC/24VAC
y.	Environmental Protection	IP 66
z.	Vandal Proof	IK10
aa.	Operating Temperature Range	-40° C to 60° C
ab.	ONVIF	Profile S & Profile G
ac.	Certification	UL, CE, EN, FCC

Technical Specification of 32 Channel NVR

S.No	Features	Specifications
1	NVR	32 Channel NVR
2	Recording bandwidth	Max 640Mbps
3	Recording Resolution	8MP4K), 5MP, 3MP ,2MP(1080P),1.3MP(960P),1.0MP(720P)
4	Display Split	1/4/6/8/9/10/13/14/16/17/19/22/25/32/36/64
5	live/Playback performance	4K: 4ch realtime , 4MP: 8ch realtime , 3MP: 10ch realtime , 2MP: 16ch realtime
6	Playback	Max 8ch playback
7	Output Interface	1 HDMI (up to 4K), 1 VGA
8	Display Resolution	1024*768, 1280*720, 1280*1024, 1440*900, 1920*1080,2560*1440, 3840*2160
9	Alarm Input/out	16ch in / 4ch out
10	Ethernet	RJ-45 port (1000M)
11	Smart Phone	iOS, Android
12	Internal HDD	8 SATA HDDs, each HDD up to 8TB support RAID 0/1/3/5/10/JBOD/CLONE
13	RS485	1 X RS485
14	e-SATA	1 X e-SATA
15	Line in	1 X Line in
16	USB	1x3.0 USB for backup/upgrade, 2x 2.0 USB for mouse

S.No	Features	Specifications
17	Support AI with deep learning supported cameras.AI-Registered quantity	10000 AI-Registered quantity
18	AI-Maximum captured quantity with deep learning supported cameras	200,000 faces
19	ONVIF	ONVIF Compliant
20	Power Supply	AC 110~240V
21	Certification	UL,CE,FCC

Technical Specification of 8 Port Industrial PoE Switch

S.NO	Parameters	Specifications
1	Interface	8 x 10/100/1000Base-T Ports POE + 2 x Gigabit SFP Slots + 1 Console Port
2	Network Protocols	IEEE802.3 10BASE-T; IEEE802.3i 10Base-T;IEEE802.3u;100Base-TX/FX;IEEE802.3ab 1000Base-T; IEEE802.3z 1000Base-X; IEEE802.3x;IEEE802.3af, IEEE802.3at
3	PoE Specification	PoE Standard: IEEE802.3af/ IEEE802.3at , PoE ports: 1-8 ports support PoE+ , Avalaible PoE Power 240 W
4	Performance Specification	Bandwidth: 20Gbps ,Jumbo Frames:9216 Bytes ,Packet Forwarding Rate:14.88Mpps , MAC Address Table: 8K
5	Forwarding Mode	Store-and-Forward
6	Protection	Lightening protection, IP30 protection
7	Power Supply	Dual DC Input - 48 ~ 57 VDC
8	Ring Management	Rapid Ring , Self recover time in < 20ms
9	Spanning Tree	IEEE802.1D (STP) ,IEEE802.1W (RSTP) , IEEE802.1S (MSTP)

S.NO	Parameters	Specifications
10	VLAN	802.1Q VLAN , Port-Based , VLAN Entries - 4K , Private VLAN Edge , Voice VLAN , Guest VLAN , Q-in-Q , 802.1v Protocol VLAN , MAC-Based VLAN , IP Subnet-Based VLAN
11	IGMP v1/v2 snooping	Supports IGMP Snooping, MLD Snooping, Multicast VLAN Registration (MVR),Supports GARP/GVRP
12	IEEE 802.3ad LACP	Dynamic Trunk , Static Trunk
13	LLDP	supports LLDP link discovery protocol
14	System management	User add / delete user; User login, operation, status, event log , Device reset, configuration save/restore, upgrade management, time setting
15	Layer 3 Switching	Static Route , DHCP Server
16	Class of Service	Port Based , 802.1p , DSCP , TCP/UDP
17	Rate Limiting	Ingress , Egress
18	Priority Queue Scheduling	WRR , Strict Priority
19	Harware Queues	8 Hardware Queues
20	ACLs	L2/L3/L4 , IPv6 Support
21	Security	Port Security (MAC-based) , IP Source Guard , Storm Control ,RADIUS Authentication 802.1x , TACACS+ Authentication , HTTPs and SSL (Secured Web) , BPDU Guard , STP Root Guard , DHCP Snooping , Loop Protection
22	DHCP	Client , Relay , Option 66 , Option 67 , Option 82
23	Event/Error Log	Syslog , SMTP (RFC821)
24	Management Access Filtering	SNMP , Web , Telnet , SSH
25	PoE Management	Scheduling , Auto-Checking , Power Delay
26	Switch Management	SNMP (v1, v2c, v3) , RMON (1,2,3 & 9 Groups) , Software Upgrade , Configuration Export/Import , Port Mirroring , LLDP (IEEE802.1AB) , LLDP-MED (IEEE802.1AB) , CDP Aware , sFlow , IPv6 Management , NTP
27	Device Management	Topology View , Floor View , Map View , Dashboard , Traffic Monitoring , Cable Diagnostics

S.NO	Parameters	Specifications
28	Fanless	Fan Less
29	Environmental	Operating Temperature -40°C to 75°C , Storage Temperature -40°C to 85°C , Humidity 5 to 95% RH
30	Industry Standard / Certifications	CE/FCC/UL
31	Shell	IP30 protect grade, metal shell
32	Installation	DIN-Rail or Wall mounts
33	Certifications	IEC 60068-2-6 ,IEC 60068-2-27 ,IEC 60068-2-32 ,EN61000-4-2 ESD, EN61000-4-3 RS, EN61000-4-4 EFT, EN61000-4-5 Surge, EN61000-4-6 CS, EN61000-4-8 PFMF ,FCC Part 15 Class A, (EN61000-3-2, EN61000-3-3,EN61000-6-4, EN61000-6-2, EN55022

5.39. E TESTING & COMMISSIONING

General

The testing and commissioning for all electrical equipment at site shall be according to the procedure laid down below.

- All electrical equipment shall be installed, tested and commissioned in accordance with the latest relevant standards and codes of practices published by Indian standards, institution wherever applicable and stipulations made in relevant general specifications.
- The testing of all electrical equipment as well as the system as a whole shall be carried out to ensure that the equipment and its components are in satisfactory condition and will successfully perform its functional operation. The inspection of the equipment shall be carried out to ensure that all materials, workmanship and installation conform to the accepted design, engineering and construction standards, as well as accepted codes of practice and stipulations made in the relevant general specifications.
- The Contractor using his own instruments, testing equipment as well as qualified testing personnel shall carry out all tests.
- The results of all tests shall be conform to the specification requirements as well as any specific performance data guaranteed during finalization of the contract. General
- At the completion of the work, the entire installation shall be subject to the following tests in presence of Employer/Consultant.
    - Wiring Continuity Test
    - Insulation Resistance Test

- Earth Continuity Test
- Earth Resistivity Test

Preparation of the Electrical System for Commissioning

- After completion of the installation at site and for the preparation of Electrical system commissioning, the Contractor shall carry out check and testing of all equipment and installation in accordance with the agreed standards, codes of practice of Indian Standards Institution and specific instructions furnished by the particular equipment suppliers.
- Checking required to be made on all equipment and installations at site shall comprise, but not be limited, to the following:
- The following checks shall be made on all equipment and installation at site:
  - Physical inspection for removal of any foreign bodies, external defects, such as damaged insulators, loose connecting bolts, loose foundation bolts etc.
  - Check for grease, insulating/lubricating oil leakage and its proper quantity.
  - Check for the free movement of mechanism for the circuit breakers, rotating part of the rotating machines and devices.
  - Check for tightness of all - cable, bus bars at termination/joints ends as well as earth connections in the main earthing network.
  - Check for Clearance of live bus bars and connectors from the metal enclosure.
  - Check the proper alignment of all draw out device like draw out type circuit breakers.
  - Continuity checks in case of power cables.
  - Checking of all mechanical and electrical interlocks including tripping of breakers using manual operation of relay.
  - Checking of alarm and annunciation circuits by manual actuation of relevant relays.
  - Check and calibrate devices requiring field adjustment/ calibration like adjustment of relay settings etc.,
  - Check proper connection to earth network of all non-current carrying parts of the equipment and installation.
  - Test reports for all meters are to be furnished.
  - These tests shall be carried out on the equipment shall include but not be limited to the above.

Cables

Insulation resistance test with 2,500V megger for high voltage power cables rated above 1.1KV grade and 1,000V megger for cables rated up to 1.1KV grade.

All cables of 1.1KV and all H.V. cables shall be subjected to high voltage test after joining and terminating but before commissioning as per relevant standards.

In each test, the metallic sheath/screen/armour should be connected to earth.

Continuity of all the cores, correctness of all connections as per wiring diagram, correctness of polarity and phase of power cables and proper earth connection of cable glands, cable boxes, armour and metallic sheath, shall be checked.

Earthing System

1. Tests to ensure continuity of all earth connections.
2. Tests to obtain earth resistance of the complete network by using earth tester. The test values obtained shall be within the limits.
3. All documents / records regarding test data, oscillographs and other measured values of important parameters finalized after site adjustment shall be handed over to the Engineer-In-Charge in the form of test reports for their future use and reference.

Electrical

1. The scope of work for testing and commissioning of the total installation shall be for the capital equipment's like switchgears, cables, etc., and also for the associated equipment like relays Cts, Pts cable etc.,
2. The scope of work for testing and commissioning of electrical equipment for the above shall include but not limited to the following.
3. Providing sufficient number of experienced Engineers, supervisors, Electricians, so that the installation can be commissioned in stipulated time.
4. All the instruments, tools, and tackles required for carrying out the testing and the bidder shall provide commissioning.
5. The testing of electrical equipments shall be carried but as per the relevant Indian standards/codes practices/Manufacturers instructions.
6. Cleaning of Electrical equipment, contracts, cleaning and greasing etc., All the equipment and material required for above shall be supplied by the bidder.
7. Correcting the panel/equipment wiring for proper functioning for the schemes required /called etc.,
8. Installation and wiring of additional equipment on panels like auxiliary Contractors, timers, etc., which may be additionally required for proper functioning of the schemes.
9. Checking of equipment earthing and system earthing as a whole.
10. Testing of all the cables.
11. Co ordination with other Contractors for testing and commissioning of interface cables.

5.40. TEST TO BE CONDUCTED

a) All tests shall be performed in the presence of the Contractor and customer/PMC/consultant. For all types of visual inspections, checking, pre commissioning, commissioning test and acceptance tests, relevant IS for the tests given therein shall be followed in addition to the instructions in this technical specification the intention of giving the few test procedures, described below, is to provide a guideline for the bidder. However bidder shall not restrict themselves in carrying out only the tests described in this document.

b) Contractor/Manufacture shall submit their proposed test procedures for approval and shall not commence testing without such approval is given.

c) Contractor shall check and test all electrical equipment and system installed and supplied them, including equipment supplied by the Engineer-In-Charge.

d) Contractor shall ensure that no tests are applied which may stress equipment above the limits for field-testing recommended by the manufacturer. Contractor shall be responsible for any damage to personnel or equipment resulting from improper test procedure including the equipments supplied by Client.

e) All defective materials furnished by the Contractor and defects due to poor workmanship revealed through field testing, shall be corrected at Contractor expense without affecting the completion of the project.

f) CLIENT reserves the right to interpret and approve all test results prior to energisation of circuits or apparatus.

g) Contractor shall visually inspect all equipment for defects immediately results upon arrival at site including those supplied by CLIENT.

h) Contractor shall test the buried earth grid and shall record the values. Contractor shall inspect and test all earthing work carried out by him, including all interconnections between ground loops, grounding of equipment and ensure all connections are permanent and that the earthing circuit is continuous.

i) Contractor shall megger and record earth resistance at various earth connection points.

j) Switchgear rated 433 volts or more shall be tested with a 1000 volts megger.

k) Auxiliary wiring rated less than 415 volts shall be tested with a 500 volts megger.

l) ALL protective relays shall be tested at sufficient points to establish their proper functioning in accordance with manufacturer’s specification and curves.

m) Operation checks and functional checks on all switchgear panels.

n) Busbar, Wires and cables rated 433 volts or more shall be tested joints check with torque wrench for tightness.

o) Continuity testing of all wires and cables with a 1000 volts megger. Cables rated less than 433 volts shall be tested with a 500 volts megger.

p) No wires or cable having resistance between conductors or between conductors and ground if less than 100 mega ohm shall be accepted.

q) All pre-commissioning test stated as per IS for respective items.

NOTE: The Contractor Shall Note That All The Rates Quoted By Them Are Including The Testing Charges For Doing The Above Tests. Scope Shall Not Reimburse Separately Any Amount For Any Testing Of Materials.

SPECIAL CONDITIONS FOR ELECTRICAL WORKS

General:

The following Special Conditions shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Special Conditions, which are at Variance with the provisions in the documents, the Provisions in this Special Conditions shall take precedence. The materials, design and workmanship shall satisfy the specifications contained herein and codes referred to. Where the technical specifications stipulate the requirement in addition to those contained in the Standard Codes and specifications those additional requirements shall also be satisfied. In the absence of any Standard / Specifications covering any part of the work covered in this tender document, the instructions/directions of engineer-in-charge will be binding on the contractor.

Tenderer, if wishes to associate sub-contractors for any of the discipline/section of the work shall state so in his technical bid. Such sub-contractors should at least be registered with CPWD or MES or Railways or P&T or any other central/state Govt in the appropriate class of contractors eligible for tendering for such section of the work.

Application for Electric Supply & / Liason

The Contractor shall be responsible for filing and follow up application for electric supply at site, obtaining CEIG approval and any other NOC from Electrical Safety Inspector of the State/Central to the project. The contractor shall carry out all the liaison work required for obtaining electric supply at site, CEIG approval and other NOC from Electrical Safety Inspector commencing from filing of application form till approval.

Inspection & Approval of the Work by Local Authority

The contractor has to obtain, if required, all clearances & approvals from any statuary authority/local bodies pertaining to whole Electrical Installation work. The contractor shall obtain all information relating to local regulations, Bye- laws, applicable if any and all laws related to his work or profession and his having to execute work as required. Contractor shall obtain approval of the installation from the relevant inspection authorities at all stages and on

completion of the installation work if any. Any fee payable to the statutory authority for obtaining approvals is required to be paid by the contractor. However the necessary reimbursement of the fee deposited by the contractor to any statutory authority (as mentioned above) will be made on production/submission of the valid documentary proof/evidence.

Training:

The contractor has to provide training to the client staff and also operate the system

(if required) for a period of one month from the date of handing over free of cost.

Pre-delivery Inspection & approval:

The contractor shall offer the pre-delivery inspection of materials at manufacturers work to the Engineer-in-charge. The intimation for such inspections shall be given at least 15 days in advance from the date of proposed inspection. PMC along with CLIENT representative may inspect any/all the materials required in this project. All the testing facilities and all the consumables including the fuel etc. shall be provided by the contractor and nothing extra shall be paid on this account.

Tender drawings

The work shall be executed as per latest working drawings to be prepared by the contractor after award of work and submitted to the Consultants/Engineer-in-charge for approval. The Drawings & data provided are for guidance to the contractor. The exact dimensions, location, distance & levels etc shall be governed by the site conditions. The tender drawings are indicative and are for the guidance of the contractor.

Shop Drawings

On the award of the work, the Contractor shall immediately proceed with the preparation of detailed working drawings showing the detail of each equipment that are to be installed and the ancillary works that are to be carried out. All the works are deemed to be included in various items of bill of quantities as applicable.

The work shall be executed as per latest working drawings to be prepared by the contractor after award of work and submitted to the Consultant/Engineer-in-charge for approval. The Drawings & data provided are for guidance to the contractor. The exact dimensions, location, distance & levels etc shall be governed by the space conditions. The tender drawings are indicative and are for the guidance of the contractor. The Bidder shall make their independent check for selection of equipments etc. The drawings appended with the tender documents are intended to show the space allotted for various equipment, bus duct, cable routes etc. besides general electrical layout. The equipment offered shall be suitable for installation in the spaces shown in these drawings / available at site. The contractor shall prepare and submit to consultants/Engineer-in-charge for approval detailed shop/working drawings of all works on award of the work.

Three sets of all such working drawings dully signed by the head of the planning & design department of the tenderer shall be submitted to the consultants / Engineer-in-charge for approval to ensure that the works will be carried out in accordance with the specifications and drawings, including such changes as may have been mutually agreed upon. All the drawings shall be received by the Consultants/ Engineer-in-charge for approval within 7 days from the date of award of work. The approval of the drawings by the Consultants / Engineer-in-charge shall in no way relieve the Contractor form his obligations to provide a complete and satisfactory Electrical installation, testing and commissioning as per intent and purpose as laid down in the specifications.

The contractor shall also take parallel action (after award of work) for submission of applications along with the drawings, documents & details etc. to various Statutory Bodies/Authorities for obtaining their approval/clearances. The contractor shall re- submit 4 sets of all the drawings to the Engineer-in-charge/Consultants within 5 days from date of receiving comments if any from the Engineer-in-charge/Consultants after incorporating the comments.

The following shop drawings shall be prepared by the External contractor for approval

i) Electrical panels and other substation equipments placement drawings.

ii) Foundation drawings of major electrical equipments.

iii) GAD of panels, DG sets, Synchronous panel, Transformers, VCBs, Solar plant etc.

iv) Pole foundation drawings.

v) Power cable and control cables laying drawings

vi) Earthing Drawings.

vii) Lightening Arrestor drawings.

Completion Drawings:

After completion of work, the contractor shall have to submit the following (Which pertains to this work) set of drawing to consultants/Engineer-in-charge. 4 sets of hard copies + 1 Tracing + 3 Soft Copy (in 'Auto CAD' applicable version) in CD of the drawings related to lift work.

Documents to be Furnished on Completion of Installation

Six sets of the following shall be furnished to Consultants / CLIENT by the contractor on completion of the work:-

i) Completion Drawings as per above instruction.

ii) Manufacturer's catalogues of all equipment and accessories, operation and maintenance manuals of all major equipment, detailing all adjustments, operation

and maintenance procedure.

iii) Manufacturer's Guarantee / Warrantee certificates of all the equipments & materials etc.

iv) Clearances/approval of various Statutory Bodies/Authorities, if required for this system.

v) Any other information the Engineer-in-charge/Consultants may deem fit. No completion certificate will be issued until the above drawings and documents are submitted to the Engineer-in-charge/Consultants.

Performance Testing at Site:

After completion of erection at site & a preliminary warm up period, acceptance trial run of a minimum period of 7 days duration shall be conducted at site. The trial shall be conducted in the presence of the Consultants/Engineer-in-charge and the test results shall be recorded in an approved format. All testing instruments that may be required for taking measurements shall be arranged by working contractor at his own cost. Tests proving the satisfactory performance of all operating gear and safety functions and controls shall be carried out. The contractor shall give ample notice of the test to the Consultants/Engineer-in-charge. The contractor shall guarantee the complete Electrical installation for a period of 12 months or as mentioned in DLP from the date of handing over the plant after successful initial testing.

The contractor shall be fully responsible for the maintenance including watch and ward of all the Electrical equipments, accessories, installations, etc. provided by him until the works are handed over to client. Thereafter, the work can be handed over to the Client along with all inventories, completion plans etc. as required.

Tools required at site

Contractor shall ensure the availability of all necessary tools which are required to measure the physical dimension like length, X-sectional Area etc. and electrical parameters such as voltage, current, Insulation resistance etc. of the electrical items. The provision for the arrangement of these tools shall be the part of the contract and nothing shall be paid to the contractor on this account.

Co-ordinations:

The Contractor shall co-operate with any other agency working in the same project, compare plans, specifications and the time schedules and so arrange his work that there will be no interference. The Contractor shall forward to the Consultants/Engineer-in-charge all correspondence and drawings so exchanged. Failure to check plans for conditions will render the contractor responsible for bearing the cost of any subsequent change found necessary or damages done. However, contractor shall afford necessary facilities to execute the work simultaneously with other agencies executing the works like Building civil work, horticulture, HVAC, Lifts, external services and other building works for the same project.

Consultants/Client shall entertain no claim on this account.

The External work shall be executed in close Coordination with the progress of building work. This being the essence of the contract, an activity chart clearly showing critical areas should be furnished before commencing the work for proper monitoring and coordination.

Handing over the works on completion:

On satisfactory completion of all the works as per the provision of the Contract, the Contractor shall hand over the works to the client. The Contractor shall ensure that all the testing commissioning & trial run operation of all the system are simultaneously carried out so as to make the same functional immediately on completion.

Contractor has to submit the test reports, manufacturer manual, and referred IS code / CPWD specification for inspection of material.

The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of local body under the jurisdiction of which the work is to be executed or as directed by the Consultants/Engineer-in-charge and nothing extra shall be paid on this account.

For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the Consultants/engineer-in-charge and nothing extra shall be payable on this account.

Clarifications of Discrepancies

In the case of Discrepancies between the schedules of quantity, the specifications and/ or the Drawings, the following order of preference shall be followed.

1. Description of schedule of quantities.
2. Technical Specifications and Special Conditions, if any.
3. Drawings.
4. CPWD Specifications.
5. Indian standard Specifications of BIS

SECTION 3 E

HVAC SYSTEM

TECHNICAL SPECIFICATION FOR HVAC

6.1 VRV / VRF OUTDOOR UNIT

Scope of Work

The specification for VRV / VRF Units covers the general design, materials, constructional features, supply, and installation, testing, commissioning & carrying out performance test at site.

Codes & Standard

The design, materials, manufacture, inspection, testing & performance of VRV / VRF shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed.

General

Each VRV / VRF Unit shall be air cooled, split type multi-system air conditioner consisting of outdoor units and number of indoor units, each having capability to cool for the requirements of the individual area to be air- conditioned. The VRV / VRF unit should be capable of connecting minimum ten different type of indoor units to one refrigerant circuit and controlled individually.

Each VRV / VRF unit shall have all inverter scroll / rotary compressor for higher reliability, improved life, better backup and duty cycling purpose. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load. Each indoor unit shall have capability to cool or heat for the requirement of the rooms.

The Outdoor units shall be suitable for mix-match connection of followingtype.

- Ceiling mounted cassette type (Double flow)
- Ceiling mounted cassette type (Multi flow)
- Ceiling mounted duct type.
- Ceiling suspended type.
- Wall mounted type
- Floor standing type
- Concealed floor standing type.
- DX AHU with dedicated set of ODU

Please note that the refrigerant piping shall be capable of extending up to 190 m of equivalent piping length with 90 m level difference without any oil traps between outdoor & indoor unit.

Both indoor and outdoor units shall be factory assembled, tested and filled with first charge of refrigerant. These being very hi-tech in construction with lots of factory checks being conducted, hence no sub assembly should be done at site preferably.

Outdoor Unit

The outdoor unit shall be factory assembled, weather proof casing, constructed from heavy gauge mild steel panels and coated with baked enamel finish. The unit should be completely factory wired, tested with all necessary controls tested prior to dispatch conforming to the following specifications.

a) All outdoor units shall consist of all inverter driven scroll / rotary compressors (For module from 18 HP & above otherwise one compressor), preferable all with inverter drive, capable to operate even when one compressor is unserviceable.

b) Outdoor units when consisting of more than 1 module (e.g. 22 HP = 10 Hp +12 HP), each should have one separate inverter driven compressors.

c) In such case, the units shall be provided with duty cycling arrangement for multiple inverter compressors.

d) The outdoor unit shall be modular in design to facilitate installation one after another close to each other. Preference would be given to compact units having smaller footprint.

e) Outdoor units should be rugged of anti-corrosion design and should have strong base plate for easy mounting of unit.

f) The outdoor unit shall comprise of sub-cooling feature to effectively use the entire coil surface through proper circuit/bridge in order to prevent flushing of refrigerant owing to large length of piping.

g) The condensing unit shall be provided with state-of-the-art microprocessor based control panel.

h) The outdoor unit shall be provided with provided with Aero spiral design fan exhibiting low noise level characteristics complete with aero fitting grille to facilitate spiral discharge of airflow to effect reduction in pressure losses. The fan should be capable to respond to external static pressure of5mm.

i) Motor shall be speed controlled to ensure a stable operation for varying ambient, by a factory fitted direct acting head pressure activated variable speed drive for at least 15 steps to give precise discharge pressure and minimum power consumption of condenser fan motor.

j) The condenser shall be complete with provisions for refrigerant piping connections, shut off valves and any other standard accessories necessary with the equipment supplied.

k) All interconnecting piping within ODU, coils, joints and U bends within the

condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.

The condensing unit shall be designed to facilitate fail safe operation when connected to multiple indoor units. If possible, the system should work on standard operating parameters like discharge pressures of not more than 300 PSI as the ref. Piping will be moving around within a residential house, otherwise on any misfortune of any leakage it will act like a bullet on higher pressures. If working on higher operating pressures, vendor to comply with all safety codes of high pressure safety & testing as recommended by Japanese (being Japanese design product) and give 2 sets of special tools to handle such equipment at site. All brazing should be done by only qualified trained person who had training on HIGH PRESSURE brazing, special tools & procedures.

Scroll / Rotary Compressor

The scroll / rotary compressor shall be an industrial quality rugged, cast iron, direct hermetic compressor with scroll plates, suction & discharge service valves. The compressor shall be completely enclosed in a chamber with no leakage path and providing the capability for scroll plates to separate. The compressor shall be provided with industrial solid motor mounts internal motor protection and vibration isolation pads. Each compressor shall be independently wired and piped to its own circuit for efficient operation & ease of maintenance. The compressor speed shall not exceed 3000 RPM.

The compressor shall be highly efficient inverter control. The inverter compressor shall change the speed in accordance to the variation in cooling orheating load requirement:

a) All outdoor units shall have multiple steps of capacity control to meet load fluctuation and indoor unit individual control. All parts of compressor shall be sufficiently lubricated stock. Forced lubrication may also be employed.

b) Oil heater shall be provided in the compressor casing.

c) The inverter compressor shall preferably be efficient & reliable inverter compressor.

Heat Exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil.

a) The aluminum fins shall be covered by anti-corrosion resin film.

b) The unit should be with heat exchanger to optimize the path of heat exchanger and for better efficiency of condenser.

c) The unit shall be provided with necessary number of direct driven low noise level propeller type fans arranged for vertical discharge. Each fan shall have a safety guard.

Refrigerant Circuit

The refrigerant circuit shall include liquid & gas shut-off valves and a solenoid valves at condenser end. The equipment must have inbuilt refrigerant stabilization control for proper refrigerant distribution.

All necessary safety devices shall be provided to ensure the safely operation of the system.

Refrigerant

The VRV / VRF units shall be selected on R410 refrigerant only. The units should be fully factory charged with refrigerant & oil & spare refrigerant & oil must be sent along with the machine for topping up of gas & oil as may be required.

Safety Devices

All necessary safety devices shall be provided to ensure safe operation of the system. Following safety devices shall be integral part of the outdoor unit:

a) High pressure switch

b) Fan drive overload protection switch Fusible plug

c) Overload relay including overload protection for inverter driven compressor.

Oil Recovery System

Entire system shall be designed and capable of oil recovery to ensure stable operation with long refrigeration piping lengths.

The system should have inbuilt (avoid external) oil balancing circuit to avoid poor lubrication.

Transit Damage

The unit shall be restored to original conditions in case of any transit damages by the contractor at his own cost.

Technical Requirement of VRV / VRF Unit

S/N	Description	Unit	Condition of Service
a)	Type	--	Cool / Heat Type
b)	Capacity (cooling)	HP (Nominal)	As Required
c)	Quantity	Nos.	As Required
d)	Connectable No. of possible indoor unit	Nos.	Refer Shop Drawings

e)	Air entering condenser	Deg. C DB	35.0
f)	Electric Supply	--	415 V/3 Ph/50 Hz
g)	Maximum Refrigerant	--	190 RMT

Piping Length for One Unit

6.2 VRV / VRF INDOOR UNIT

Scope of Work

This section deals with supply, erection, testing and commissioning of Various Type of Indoor Units confirming to general specification and suitable for the duty selected.

General

Indoor units shall be either ceiling mounted cassette type, or ceiling mounted ductable type or floor standing type or wall mounted type or other as specified in design basis. Each unit shall have electronic control valve to control refrigerant flow rate respond to load variations of the room.

a) The address of the indoor unit shall be set automatically in case ofindividual and group control
b) In case of centralized control, it shall be set by liquid crystal remotecontroller

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.

Each indoor unit shall have computerized PID control for maintaining design room temperature. Each unit shall be provided with microprocessor thermostat for cooling or cooling and heating.

Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall have self-diagnostic features for easy and quick maintenance and service. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

Ceiling Mounted Cassette Type Unit (Multi Flow Type)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and DX-coil section. The housing of the unit shall be powder coated

Galvanized steel. The body shall be light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo fan type. Also Units shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center.

Each unit shall have high lift drain pump, fresh air intake provision (if specified) and very low operating sound.

All the indoor units regardless of their difference in capacity should have **same decorative panel size** for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

Ceiling Mounted Ductable Type Unit

Unit shall be suitable for ceiling mounted type. The unit shall include pre filter, fan section & DX coil section .The housing of unit shall be light weight powder coated galvanized steel. The unit shall have high static fan for Ductablearrangement.

Ceiling Suspended Type

Unit shall be suitable for ceiling suspended arrangement below false ceiling. The unit includes pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

Hi Wall Mounted Unit

The units shall be wall-mounted type. The unit includes pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

Unit shall have an attractive external casing for supply and return air.

Floor Standing Type

Unit shall be suitable for floor standing arrangement. The units include pre filter, fan section & DX coil section. The housing of unit shall be light weight powder coated galvanized steel.

Centralized Type Remote Controller

A multifunctional compact centralized controller of touch screen type and of latest generation shall be provided with the system. Local controller shall also be of latest generation.

The controller to act as an advanced air-conditioning management system to give complete control of VRV / VRF air-conditioning Equipment, It should have ease of use for the user and must have a user friendly panel and display.

It shall be able to control up to minimum 64 indoor units with the following functions:-

a) Starting/stopping of Air-conditioners as a zone or group or individual unit.

b) Temperature settling for each indoor unit or zone.

c) Switching between temperature control modes, switching of fan speed and direction of airflow, enabling/disabling of individual remote controller operation.

d) Monitoring of operation status such as operation mode & temperature setting of individual indoor units, maintenance information, troubleshooting information.

e) OPTIONAL-Display of air conditioner operation history.

f) OPERATIONAL-Daily management automation through yearly schedule function with possibility of various schedules.

The controller shall have wide screen user friendly display and can be wired by a non-polar 2 wire transmission cable to a distance of 1 km. away from indoor unit.

Colour

The colour of indoor units should be white or to suit interiors as designed by the architects / clients.

6.3 DOUBLE SKINNED DX VRV / VRF AHU

Scope of Work

The specification for Double Skin DX Air Handling Units (AHRI / Euro - Vent Certified) with Air Cooled VRV / VRF Outdoor Unit covers the design requirement, constructional feature, supply, installation, testing & commissioning. The floor mounted horizontal type air handlers shall be of double skin construction, draw through type comprising of various sections such as Pre / Fine filter section, Cooling coil section, CoiloTron section, fan section etc. as required.

Codes & Standard

Complete AHU shall be AHRI Standard 410-2001 or Latest Edition / Euro- Vent BS EN 1886: 1998 or Latest Edition, certified for minimum followings category.

a) AHUs shall CE certified for Electrical & Mechanical safety.

b) Filter Bypass Leakage-Class -F9 / BS EN 1886: 1998 Clause: 6 shall be required.

c) Thermal Transmittance- T1 / BS EN 1886: 1998 Clause: 7 shall be required.

d) Mechanical Strength – D1 / BS EN 1886: 1998 Clause: 4 shall be required.

e) Casing Air Leakage –L2 / BS EN 1886: 1998 Clause: 5 shall be required.

f) Thermal Bridging –Class TB2 / BS EN 1886: 1998 Clause: 7 shall be required.

Double Skinned Air Handling Units Double Skinned Casing

The casing shall be self-supporting type, factory fabricated & assembled made of extruded anodised aluminum hollow sections to make a rigid frame structure. The frame shall be assembled using pressure die cast aluminum joints. The self-supporting unit shall consist of sandwiched panel made out of

1.0 mm thick pre-plasticide / pre-coated GI sheet outside & 0.8mm GI sheet inside duly factory fabricated insulated with 48 mm thick for indoor / outdoor application PU foam insulation in between. The insulated panels shall be bolted to mainframe with neoprene rubber gaskets held captive in the framed extrusion to make it leak proof. Suitable airtight access doors / panels with pressure die cast aluminum hinges & nylon handles and locks shall be provided for access to various sections for maintenance. The Entire housing shall be mounted on Extruded Aluminum channel framework having pressure die cast aluminum jointers or the framework shall be joined together with corner plates Condensate. Drain Pan shall be constructed of 22 gauge Stainless steel sheet with all corners welded with uniform slope from all sides leading to drain pan ensuring no stagnation of condensate water.

Water resistance marine light with power cabling shall be included.

Micro switch with wiring for Door shall be provided such that fan motor shall stop upon opening the door.

Motor & Drive

The fan motors shall be suitable for 415 ± 10% volts, 50 ± 5 % HZ, 3 phases TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation. Motor shall be suitable to operate with belt driven fans With VFD motor.

Fan

Fans shall be backward curved plug fan with aerofoil design blades so as to give maximum efficiency for given duty condition fan. The fan shall be AMCA certified and the entire Fan + Motor assembly shall be balanced before dispatch. Fans shall be selected for minimum efficiency of 65**%.** Multiple fans / single fan shall be used in AHU to suit available AHU Room at site & as per approved shop drawing. The fan impeller shall be supported to housing with angle iron frame & pillow block heavy duty ball bearing. The fan housing with TEFC Sq. Cage motor shall be mounted on a common adjustable base frame on vibration isolators / rubber turret mounts vibration isolators. The fan motor shall be installed inside the housing of air handling unit to keep low noise level. The fan & motor assembly shall be of aluminum extruded section only.

AHRI Certified DX Cooling Coils

The Cooling coil should be at least 8 row deep or as per BOQ and shall have at least 4.7

fins/cm. The Cooling coil should have aluminum fins and copper tubes mechanically bonded. The unit shall be factory aligned, tested and complete with refrigerant piping connection port, charging valves, thermostatic expansion valve, distributor, liquid strainer, dehydrator, liquid line shut off valve etc.

The cooling coil should be tested for leaks at a hydraulic pressure of at least 10 Kg / sq.cm for a minimum period of 3 hours at works. The velocity across face should be limited to 152 meter / minute.

Computerized cooling coil selection output shall be submitted. Coil rating shall be as per AHRI-410 / EUROVENT Certified.

Filters

Each unit shall be provided with a factory assembled pre-filter section containing washable synthetic tube air filters having extruded aluminum frame. The filtration efficiency shall be as per MERV 8 rating. Filters shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filters cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Face velocity across filters shall not exceed 152 MPM.

Wherever fine filters are required to be installed, AHU shall be provided with fine filter sections with filters in double skinned construction. The frame of fine filters shall be Aluminum anodized. The media for fine filters shall be non- woven synthetic supported by HDPE mesh on one side & aluminium expanded mesh on other side. The filtration efficiency shall be as per MERV 13 rating respectively or as required as per ASHRAE Health Care Guidelines.

Following Codes & Standard shall be followed.

a. ASHRAE 52.1: Gravimetric and Dust spot procedures for testing Air cleaning devices.

b. IS 7613: Methods of testing panel type Air filters for HVAC

The housing shall be made from extruded aluminium sections. All joints shall be sealed airtight and shall be made free of all burrs and sharp edges. The filter loading mechanism shall be sliding type or front loading type. The locking mechanism shall be a spring loaded, toggle type mechanism with a bolt and thrust assembly which shall thrust the filter evenly against the sealing flangeof the housing when it is installed.

Isolators

Vibration isolators shall be provided to all air handling units. The fan and motor framework shall be isolated from the AHU framework by means of spring type vibration isolators. The AHU shall be mounted on 6 inch high PCC block suitable for weight of the AHU. The platform shall be 4 inch bigger than the AHU frame size from all sides. The framework of the AHU and the P.C.C. block shall be isolated by means of neoprene mats of size 150mmx150mm in two layers with 16g G.S.S. sheet sandwiched in between.

Accessories

Minimum 2 Nos. nameplates (1 in etched metal and other plastic) mounted onto AHU panel with suitable water-resistant adhesive along with relevant warning stickers on various panels. The nameplate shall give all relevant details including fan model selected, motor KW, Air quantity and total static pressure.

Noise Control

Air Handling Units shall be selected for the lowest operating noise level of the equipment. Fan performance rating, power consumption, and sound power data with operating points clearly indicated shall be submitted by the tenders along with technical submittals for approval and verified at the time of testing and commissioning of the installation. The sound level within the AHU room shall be less than 60 dB at a distance of 1 meter from AHU.

Testing

Cooling capacity of various Air handling units shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by a calibrated rotating vane anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current, whereas, noise level at various locations within the conditioned spaces shall be measured by a sound pressure level meter.

6.4 VENTILATION FANS

Scope of Work

The specification for supplies & exhaust air blowers for mechanical ventilation covers the design requirement, constructional feature, supply, installation,testing & commissioning.

Type

The blower shall be of Tube Axial Flow fans / Centrifugal Fans / Inline fans / Propeller Fans / Jet Fans with or without ducting system & shall be of floor mounted / ceiling hung type.

Capacity

The capacity of Tube Axial Flow fans / Centrifugal Fans / Inline fans / Propeller Fans Jet Fans, diameter, maximum motor H.P & static pressure etc. shall be according to schedule of quantities.

Axial Flow Fans

The exhaust air blower shall be Tube Axial Flow fans connected to the duct & shall be of floor / ceiling / wall mounted type as specified in the Bill of Quantities / GFC Drawings / Shop Drawings. The capacity of tube axial flow fans, diameter, maximum motor H.P & static pressure etc. shall be according to schedule of equipment & Bill of Quantities. The noise

level of axial fan shall be less than 80 dBa at a distance of 3.0 mt from the fan.

Axial Flow Fan shall be **AMCA certified** for Air and Sound performance in accordance to **AMCA 210 and AMCA 300**.

The cylindrical casing shall be made from MS / GI welded carbon steel sheet. The length of casing shall be long to accommodate motor within the casing. Casing thickness shall be minimum 2mm up to 800 mm dia fan, 3 mm thick from 900 to 1250 mm dia & 4 mm thick above 1300 mm dia. The inlet & outlet of the casing shall be fitted with flanges for ductwork connection & other accessories as required. The casing shall be coated with minimum 2 coats of rust proof primer and enamel paint thereafter or to be Powder Coated after phosphating process. The blade of axial flow fan shall be made of die cast aluminium alloy. The blade angle shall be set at manufacturing place & shall be adjustable at site. The hub shall consist of two half-hubs pressed in carbon steel & the centre boss shall be made of die-cast aluminium alloy. The blade feet shall be locked in two half - hubs. The design shall facilitate the alteration of blade angle without disconnecting the hub from the motor shaft. The fan shall be directly driven by TEFC sq. cage induction motor. The fan motors shall be 415±10% volts 50HZ ± 5%, 3 phase TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation & motor RPM shall be as given in Bill of Quantities.

All the fans selected for smoke extraction shall withstand 250 °C temperature for 2 hours & shall work satisfactorily at this temperature. Motors selected for this application shall be certified according to standard BS EN 12101-3:2002 / UL in accordance with "Power Ventilators for Smoke Control Systems" for 250 °C for 2 hours. Complete Fan for smoke extraction application shall be tested and approved by Exova Warrington fire / Equivalent Internationally recognized Independent Fire Laboratory in accordance with BS EN 12101-3:2002 / UL standard for "Powered Smoke and Heat Exhaust Ventilators for Smoke Control Systems" for (250 degree C) temperature for a 2 hours of operation.

Centrifugal Fans

The Centrifugal blowers shall be double / single inlet, double / single width, forward / backward curved as given in the BOQ & of non-overloading type of suitable construction. The blower performance must be rated in accordance with approved test codes and procedures. The centrifugal fans should confirm to IS – 4894 – 1987 (Revised as on date) The blower housing comprising of scroll & side plates shall be accurately cut of heavy gauge construction and reinforced with angle bracings. Outlets shall be flanged to assure proper duct connection. Inlet cones shall be spun venturi type, to ensure smooth air entry. The base frame shall be GI / MS channel in bolted / welded construction. Impeller shall be fabricated from sheet steel with backward / forward curved, properly designed blades, with heavy C.I. Hub and shall be both dynamically and statically balanced, to a close tolerance for quiet and vibration free performance. Shaft shall be EN-8., more than 40 mm diameter and shall be accurately ground and polished to a close tolerance. Bearings shall be self-aligned, heavy duty ball or tapered roller type with integral dust and grease seals. Fan having wheel diameter of 1220 mm or more, shall be supplied with split, bolted housing for convenience of handling

and installation.

Drive assembly for each blower shall consist of blower pulley, motor pulley, and a set of 'V' belts, belt guards, and belt tension adjusting devices. Pulleys shall be selected to provide the required speed. They shall be multi-groove type, with section and grooves selected to transmit 33% more load than the required power and shall be statically balanced. The belt guards shall be of M.S. sheet with angle iron reinforcements and expanded metal screen. The fan motors shall be 415±10% volts 50HZ ± 5%, 3 phase TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation & motor RPM shall be as given in Bill of Quantities.

Propeller Fans

The Propeller Fan blades shall be pressed steel of aerofoil design for high fan efficiency and static pressure. The blades shall be riveted to a central steel hub. The motor and blades assembly shall be mounted in a cast iron / sheet Steel frame with steel brackets. Rubber mounts shall be provided between the mounting frames and brackets. The fan motor shall be totally enclosed type.

In-Line Fans

Inline fans shall be complete with centrifugal impeller, casing, direct driven motor, vibration isolators, direction of discharge and rotation position shall be as per the job requirement and shall be marked on the fan assembly. Housing shall be constructed of hot rolled GSS sheet metal construction. Housing metal parts shall be either spot-welded or screwed or mounted together with rivets. Indication showing rotation arrow and make, model number and duty conditions of the fan shall be available on the housing. Fan wheel shall be forward curved type, statically and dynamically balanced. The fan shall be provided with ball bearings can be used in any mounting position at maximum indicated temperature.

Jet Vent Fan

The fans shall be die-cast aluminium alloy impeller shall be high temperature applications 300 Deg C for 2 hours operation. Fan shall be balanced dynamically and statically. The Casing of Fans shall be made of hot dipped Galvanized steel / powder coated with flanges at both ends. The Motor shall be run on the electrical power suitable for 50Hz. The certification of fans should be in accordance with EN 12101-3 or shall be UL. Fan shall be either EN / UL listed & Stamped for electrical components. The fans shall be protection guards at inlet & outlet side. The Fans shall be silencers manufactured from Galvanized steel length minimum 900 mm to achieve specified noise levels. Fans shall have Inlet cone & out cone made of Galvanized steel. The pre-wired Terminal box is mounted at the outer fan Casing. The unit shall be with mounting brackets for ceiling suspension. Final locations of the jet fans shall be based on the CFD simulation to be submitted by contractor before manufacturing. The Jet Fan Supplier shall include the cost of CFD Analysis & shall select the size and positioning of the fans, giving velocity vectors, static pressure contours, simulations of smoke spreading and

other information required for the project.

Air Curtain

Air curtains shall be wall mounted commercial type with low noise suitable for door opening width plus 300mm. The units shall provide a minimum velocity of 1.5m/s at the floor level. The air curtains shall include air blower, distribution nozzle, return air grille and filter. The enclosure shall be G.I.powder coated / ABC plastic suitable for exposed installation.

Accessories

All necessary accessories shall be provided for proper operation and shall also include as part of Unit Price.

- Dunlop cushy foot vibration isolators for the blowers
- Double canvas connections at the outlets of each fan
- Nuts, Bolts, Shims etc. as required for the grouting of the equipment
- Slide rails for mounting the motor and belt adjustments
- Bird Screens in the Inlet
- Detachable and washable fresh air filters at the inlets

Performance Data

All fans shall be selected for the lower operating noise level. Capacity ratings, power consumption, with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. All the fans should be AMCA certified for sound and performance. Complete certified model appearing on AMCA web site shall be accepted.

Testing

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current. Contractor has to carry out the field balancing, if required.

6.5 COILOTRON / UVC EMITTERS – MOUNTING IN AHU

Scope of Work

This section deals with supply, installation testing & commissioning of CoiloTron / UVC Emitters System inside the AHU with accessories to reduce mold and fungus growth on the coil / drain pan and keep the cooling coil surface clean as required conforming to these specifications and shall be in accordance with Bill of Quantities. The AC Contractor shall depute CoiloTron representative for co-ordination during manufacturing of AHU & also for startup, testing, commissioning & performance test

at site. Emitters shall be Double Ended Type and each fixture shall have 2 lamps. The lamps shall be high output type 800 mA each. Energy output of the lamp measured 3'3" (1M) from the Lamp shall not be less than 144 µwpercm². The lamps shall be rated for useful lamp life not less than 11,000 hours.

Design Requirements Irradiation

1. Emitters and fixtures are to be installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain pan.
2. The system shall comprise one or more number of individual units or fixtures, all mounted on factory provided metallic frame. All necessary materials to form the frame including mounting supports, screws, and hardware shall be factory provided.
3. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected and shadowed losses. The reflector shall be mirror surface with specular property not less than 86 % reflectivity to ensure maximum reflection of produced UVC rays on to the Cooling Coil and drain pan.

Intensity

1. The lamps shall operate at wave length of 254 nM and not at 180 nM or lower, to ensure no uncontrolled ozone is put out by the lamps.

Installation

1. Emitters and fixtures shall be installed downstream of the cooling coil at right angles to the coil fins, such that UVC energy bathes all surfaces of the coil and drain pan. The wiring kit for emitters shall be supplied by manufacturer. Installation of UV fixtures on vertical support structures shall allow easy movement of lamp fixtures as needed to cover the entire surface area of Cooling Coil and drain pan with UV radiation

Equipments

1. Units shall be high output, HVAC type, and germicidal UVC light sources, factory assembled and tested. Components shall include a housing, reflector, high efficiency electronic power source, Emitter sockets and Emitter tube, all constructed to withstand HVAC environments. All electrical connections within the fixture or frame shall be factory ready, ending on terminals. All fixtures within an AHU shall be daisy looped. All electrical cables shall be UL Listed. It shall be possible to connect all the UV frames or fixtures within an AHU easily and quickly with minimum labor time, opening the terminal box alone, and without opening the fixtures.

2. Each lamp shall be housed individually in a quartz sleeve equivalent to GE 214 to ensure high rate of transmission of UV intensity. The quartz sleeve shall cover the entire length of the lamp and lamp holders. The quartz sleeve is essential to ensure multiple beneficial features;
    - Prevent carry over moisture from Cooling Coil from contacting lamp surface.
    - Prevent dust particles settling on lamp surface
    - Ensure lamp surface is maintained at constant temperature and to prevent cooling of lamp surface due to passage of air over it.
    - Contain and hold mercury from spilling into the AHU section, in the event of breakage of lamp. This is required to ensure compliance to environmental codes.
    - Facilitate environmentally safe disposal of broken lamp
3. Final finished UV Fixture shall be Listed to UL 1995
4. Final finished UV Fixture shall be tested and certified to comply to Fire and Smoke Safety to UL 2043

6.6 ULTRA VIOLET GERMICIDAL IRRADIATION SYSTEM (UVGI)

Scope of Work

This section deals with supply, installation testing & commissioning of UVGI System duct mounted type with accessories as required conforming to these specifications and shall be in accordance with Scope of Works given. The AC Contractor shall provide specialized agencies representative for site coordination; start up, testing, commissioning & performance test at site.

Specification

1. The basis of design of the UVGI System shall be to achieve 90% kill rate per pass based on the kill rate required for Escherichia Coli (E coli). However, it shall be suitable to achieve kill rate of all air borne mold, spores, bacteria and viruses, at varying extent of kill rate.
2. In the event any specific bacteria, virus, or disease is mentioned, the UVGI System shall be designed to achieve the above kill rate based on the specified bacteria or the bacteria that causes the defined disease.
3. The entire UVGI System shall be self-contained unit, with all components factory assembled in one neat compact package, suitable for duct mounting. All metallic components in contact with air (wetted parts) shall be of SS 18 G thick. The outer frame that attaches to the ducting shall be 18G CRS and powder coated.
4. UV emitting tubes shall be spaced to ensure the entire cross sectional area of the duct is enveloped with UV rays of the specified wavelength with no possibility of

bypass by pathogens.

5. The UV tubes shall be of super high output of 800 mAmps each. Special interior coating shall be provided to the lamp to extend lamp life of 9,000 Hours based on Switch Rate of 3 per day. The lamp shall deliver energy not less than 3,000 mW-Sec/cm² within UV wavelength 250 to 260 nm. The energy consumed by each lamp based on 17" length should not exceed 20W.
6. Emitter Igniters shall be connected to a nickel inner lead 8mm wide, triple coiled, tungsten coated, clamped filament type, to minimize quartz solarization and enhance plasma convention and stability. The base shall consist of 2 power pins at each end permanently fixed into a high impact insulating base with encasing pins to provide highest electric conductivity. The lamp output shall not be less than 7.5 µW/cm² at 1 M, per each inch of emitter arc length with no reflective assistance when placed in moving air at 45ºF (7.5ºC). The lamp shall comply with general provisions of IES Lighting Handbook 1781 Applications Volume.
7. The UVGI assembly shall be provided with suitable flanges to mount it in the chosen duct section.
8. The outer casing shall be provided an On/Off Switch. A Timer and Indicating Lamp shall be provided, to signal lamp change-out when the full lamp life is reached.
9. The entire system shall be provided with interlock to shutoff the lamps in the event the duct section is opened.
10. The operating voltage shall be 220V, Single Phase, 50Hz (110V, Single Phase, 60Hz). The equipment shall be properly grounded.
11. The System shall be ETL Listed.

6.7 VARIABLE FREQUENCY DRIVES

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of variable frequency drives conforming to these specifications and in accordance with Bill of Quantities. The VFD should be specially designed & applicable for HVAC field & general-purpose product shall not be acceptable. AHU VFD shall be with IP-54 enclosure, Optional mains disconnect & 2 PID controllers as defined in BOQ.

Certification

Low Voltage Directive 73/23/EEC with supplements

Machinery Directive 98/37/EC & EMC Directive 89/336/EEC with supplements CE, UL, BTL and cUL approvals

GOST R certificate, RoHS Directive 2002/95/EC & SEMI F47

VFD Design Requirements

1	Voltage Variations	380-480V
2	Nominal supply frequency	50 Hz ± 5%
3	True Power Factor (λ)	> 0.9 at nominal rated load
4	Displacement P.F. (cos φ)	> 0.98
5	Short circuit current rating	100 kA RMS
6	Harmonic current control	The VSD shall have inbuilt AC or DC chokes to minimize the Total Harmonic Distortion (THD). The VSD shall provide up to 25% less harmonics over traditional choke solutions
7	EMC Compliance (for emission and immunity)	The VSD must have inbuilt EMC filters as standard. The range of VSDs shall conform to the European Union Electro Magnetic Compatibility (EMC) Directive, a requirement for CE marking. VSDs must comply with EMC Directive 89/336/EEC with supplements and Product Standard EN 61800-3 Class C2 (1st environment restricted distribution) as standard with inbuilt Filters with minimum cable lengths of at least 75m.
8	VFD rated continuous output current	Meet or exceed the normal rated currents of standard IEC induction motors
9	Torque mode	Variable torque.
10	Torque ratings	a) Starting torque: 180% for 2 Seconds. b) Overload torque: 110% for 1 minute.
11	Cable lengths	a) Up to 150 m for screened / armored cable. b) Up to 300 m for unscreened /armored cable
12	Cable type	To allow for SWA (Single Wire Armour) cable & MICS (Mineral Insulated Copper

		Sheath) cable in the motor circuit.
13	V/f ratio	Dynamically varying; fixed V/f curves not acceptable
14	Energy optimization function	Automatic energy optimization algorithm, which continuously adjusts the applied voltage based on load and speed.
15	Output power switching	Without any interlocks and damage toVFD
16	Motor tuning function	Automatic, without having to decouple the load and motor.
17	Signal Isolation	Galvanic Isolation between power and control circuitry
18	System response time	< 2 ms
18	Motor noise reduction	Adjustable carrier frequency modulation.
20	Ramp time	Programmable from 1 to 1800 seconds.

VFD Service Conditions

1	Ambient Temperature with full VFD rated outputcurrent:	40^0C without deration throughout the P P Power range.
2	Relative Humidity	0 to 95%. non condensing
3	Max. altitude above sea level	Up to 1000m without derating. Reduced by 1% per 100m over 1000m up to 2000m.
4	AC line voltage variation	+10%/ -15% of nominal with full output.
5	VFD enclosure protection	IP21/IP54 integral with no additional cabinets
6	Aggressive environment	Class 3C2
7	Vibration	1.0 g

VFD Protective Features

1	Motor overload protection	Class 20 I^2t electronic motor overload P P Protection with automatic compensation for

		changes in motor speed.
2	Protective functions	Against input transients, loss of AC line phase, output short circuit, output ground Fault, over voltage, under voltage, VFD over temperature and motor overtemperature.
3.	Function at input phase loss	Auto derate and warning. Should cause no damage to VFD
4	Function at over temperature	Automatically reduce carrier frequency or auto derates.
5	Function at over load	Automatically reduce output current to a pre-programmed value
6	Alarm log	Record last 3 alarms with full history of alarm, date & time.

VFD Interface Features

1	Customer interface	Identical interface for full range of VFDs in a project
2	Display type	Multiline LCD Display with diagnostic assistant.
3	Auto – Manual operation	Control panel to have inbuilt Hand – Off – Auto Keys.
4	Programming assistance key	Key for displaying on-line context Sensitive assistance for programming and troubleshooting.
5	Protection against unauthorized access	Single level password protection to prevent unauthorized protection.
6	Parameter up load / download	Control panel with program up load / down load function and also size / rating independent parameters.

9	Languages	English
10	Indicating lamps	Red FAULT light, yellow WARNING light and a green POWER-ON light.

VFD HVAC Features

1.	Quick set up menu	Menu with factory preset typical HVAC parameters
2	HVAC application menus	Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
3	Speed control using 2 feedback signals	A two-feedback PID controller as a standard.
4	2 – zone control	Sum, difference, average, compare to common set point or compare to individual set point and select min. or Max. deviating signal
5	Square root function of feedback signal	Calculate the square root of any / all individual feedback signals so that a pressure sensor can be used to measureair flow
6	PI programming	Auto tuning PI controller to facilitate faster commissioning
7	Installation of pressure sensor near to output of pump.	Actively adjust its set point based on flow, to facilitate such installation
9	Floating point control interface	To increase/decrease speed in response to contact closures.
10	Meter displays	3 simultaneous meter displays on LCP.
11	Display of feedback signals and set points	Display all connected feedback signals and its set points, in their own engg. Units (e.g.: bar / ^{0}C etc.)

P P

12	Sleep mode	Programmable and be able to stop the VFD in the following situations: a) Output frequency drops below set "sleep" level for a specified time, b) External contact commands that the VFD go into Sleep Mode, or c) Detects ano-flow situation.
13	Run permissive circuit	Receive a "system ready" signal before starting and also be capable of initiating an output "run request" signal to the External equipment.
14	Loss of load detection	Monitor a broken belt / loose coupling and indicate via keypad warning, relay output or serial communication. This function shall be based on torque and shall have a proof timer.
15	Real time clock	Integral feature and shall be capable of: a) Display current date & time on control panel b) Start / stop, change speed depending on time c) Time stamp all faults d) Program maintenance reminders based on time
16	Energy log	Function to monitor energy consumption pattern over programmable hours, days & weeks
17	Load profile	Store a load profile to assist in analyzing system demand and energyconsumption
18	Sequential logic controller	To perform logic functions which has logic operators, comparators and timer functions.
19	Cascade controller for multiple motors	To control one variable speed motor and 2 fixed speed motors. Software to have full functionality and not just on / off
20	Automatic restart	To automatically restart on receiving power after a power failure
21	Adjustable ramp time	To avoid nuisance tripping, automatically adjust the ramp times.

22	Catching a spinning fan	To have a flying start function to effectively control an already spinning fan – in both forward and reversedirection
23	Programmable current limit	Programmable for site / application requirement. Shall be able to program for trip after an adjustable time
24	Start Delay	A programmable start delay shall be provided.
25	Critical frequency lock out	a) Semi-automatic setting of lock out range. b) 4 such lock out ranges to be provided

VFD Input & Output

1	Digital inputs	At least 6 programmable digital inputs
3	Relay outputs	At least 2 programmable relay outputs (Form C 240 V AC, 2 A) with adjustable on/off delays. At least 3 programmable Relay outputs (250 V AC, 2 A Continuous rms) with adjustable on/off delays.
4	Analog inputs	At least 2 programmable analog inputs, independently selectable for Voltage (0- 10V DC) or Current (4-20mA) inputs
5	Display of analog signal	The Local Control Panel to display each analog signal in its engg. Units for troubleshooting & setup.
8	Serial com interface for AI/DI	Capable of reading the status of all analog and digital inputs of the VFD through serial bus communications
9	Serial com interface for AO/DO	Capable to command all digital and analog outputs (including options) through the serial communication bus

10	Fire over ride mode	On receipt of a digital fire input, override all other local or remote commands, ignore most normal safety circuits including motor overload, display FIREMODE, select forward or reverse operation and speed source or preset Speed.

VFD Serial Communications

1 The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

1. Modbus RTU
2. BACnet/MSTP
3. Johnson N2
4. Siemens FLN APOGEE

Protocols that have a governing authority shall be certified. Use of non- certified protocols is not allowed. Following certifications must apply: BACnet: BTL (BACnet Testing Laboratories) approval

Lon Works: Lon Mark approval

Johnson Controls N2: Metasys^{TM} Connectivity partners listing Siemens Building Technologies: APOGEE Anywhere^{TM} approval

6.8 AIR COOLED HI WALL SPLIT UNIT

Scope of Work

The specification for hi wall split unit covers the general design, materials, constructional features, supply, installation, testing, commissioning & carrying out performance test at site.

Codes & Standards

The design, materials, manufacture, inspection, testing & performance of Hi Wall Split Unit shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed.

Cabinet of Indoor Unit

The cabinet of Indoor units shall be fabricated as per the standard of manufacturer and

finishes shall be attractive. The cabinet shall have removable panels to allow easy servicing of unit, giving easy access into the unit.

Compressor

The compressor shall be hermetically sealed rotary / reciprocating compressor. The compressor should be suitable to withstand voltages varying from 180 to 240 volts.

Air Cooled Condenser

The Air cooled condenser should have high efficiency condenser coils having copper tubes & collared aluminium fins with serrated edges & wavy airways to ensure sub cooling. The air cooled condenser should be housed in factory finished cabinet duly enamel painted. The air cooled condenser should have aluminium fins mechanically bonded with copper tubes.

The fan of the air-cooled condenser shall be statically / dynamically balanced and driven by single phase motor of suitable horse power.

All interconnecting piping within ODU, coils, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.

Cooling Coil

The Cooling coil should be at least 2 Row deep and shall have at least 4.7 fins/cm. The Cooling coil should have aluminium fins and copper tubes mechanically bonded. The unit shall be factory aligned, tested and complete with refrigerant piping, complete with charging valves, thermostatic expansion valve, distributor, liquid strainer, dehydrator, liquid line shut off valve etc.

The fan & fan motor should be able to take static pressure drop in coil, filtersetc.

The unit should be factory wired and tested.

The air filter should have large surface and dust holding capacity which must be easily removable type for cleaning purposes.

TECHNICAL SPECIFICATION FOR ELECTRICAL ITEMS

6.9 ELECTRICAL MOTORS

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of all types of motors used for HVAC Units conforming to these specifications and in accordance with Schedule of Quantities. The motor installation, wiring & its control shall be carried out in accordance with the specifications as detailed below.

Motors

The motor shall be of the following design and should run at all loads without any appreciable noise or hum.

Totally enclosed fan cooled Sq. Cage.

Enclosure and type of motor shall depend upon duty and usage unless otherwise specified.

The winding of motors shall be class 'B' insulation and suitable for local conditions. The insulation of motors shall confirm to IS: 325/1978.

All motors shall comply with IS: 325, IEC-34.1 or BS – 2313, IEC-72.1 for foot mounted motors.

The rating of the motor shall be as indicated in the Schedule of Quantities. The motors shall be selected on the basis of ambient temperatures and allowable maximum temperature rise.

Motor above 1HP shall be three phase unless otherwise specified.

All motors shall be rated for continuous duty as per IS: 325. Motor shall be suitable for operation on 415 volts ± 10% volts, 50 ± 5% Hz three phase AC supply (or 230 ± 10% volts, 50 ± 5% Hz for single phase ACsupply).

Motors shall be provided with cable box to receive Aluminum conductors, PVC insulated, PVC sheathed and armored cables.

All motors shall be provided with combination of 'Ball and Roller Bearing'. Suitable grease nipples for regreasing the bearing shall be provided.

Motors above 0.25 HP shall be provided with overload protection. Motors above 100 HP shall be provided with thermal protection and thermistor detector in the stater winding.

The starter current and the type of starter to be used shall be as follows (unless otherwise specified)

	Type of motor	Starting Current	Starting method
a)	Sq. Cage motor up to 7.5 HP	600% of full load current	D.O.L
b)	Above 7.5 HP up to 60 hp	250% of full load current	Star / Delta
c)	75 HP & above	200% of full load current	Closed transition Star / Delta or Double Star

Motor Starters

ll starter shall confirm to IS: 13947. The starter shall be enclosed in sheet metal enclosure, which would be dust vermin proof.

All starter should have suitable range of voltage and frequency.

All starter shall have integral stop/start push button of international colour code.

Contactor shall have number of poles as required for appropriate duty. Contacts should be made of solid silver faced & shall be suitable for at least 40 contacts per hours.

In event of power failure, the starter should automatically disconnect.

All starters shall be provided with thermal over load relay.

All-star delta starters shall have adjustable timers.

Terminal blocks with integral insulating barrier shall be provided for each starter.

All starters shall be provided as specified in Schedule of Quantities. All starter shall be compatible to the drive and driven equipment.

Extra contact for interlocking purpose shall be provided in the starter.

All starter shall be compatible for Auto / Manual operation.

All starter shall have separate single phasing preventer.

Installation of Motors

The motor and drive machine shall be fixed on slide rails to facilitate belt and other adjustments.

Vibration Isolation arrangement shall be provided.

The installation of motor shall be carried out as per IS: 900.

The motor with driving equipment shall be mounted on foundation and connected to each other with flexible coupling with guard in condenser & chilled water pumps.

All motor shall be wired as per specifications. Earthing of motor frame shall be done with GI strips as specified in ‘Schedule of Quantities’.

All motors shall be tested at manufacturer’s works as per I.S. standard and test certificates shall be furnished.

All motors after AC contractor shall test installation at site for vibrations, heating and

electrical insulation resistance.

Motor Control Centre, Ventilation Sub Panel, Power & Control Cabling, Earthing etc.

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of motor Control Centre, Ventilation Panels, AHU Sub Panel, power / control cabling & earthing work shall be carried out as per the specification given below and in accordance with Schedule of Quantities. All work shall confirm to Indian Electricity Act (amended up to date), I.S. code of practices, local rules and regulations etc. The codes & standard to be followedshall be as given below:-

- BIS 13947 (Part 4) - AC contactors up to 1000V
- BIS 13947 - AC Circuit Breakers
- BIS 2705 - Current Transformers
- BIS 3156 & 4146 - Potential Transformers
- BIS 4064 - Air break switches for voltage not exceeding1000V
- BIS 13947 - Control switches
- BIS 1822 - Motor duty Switches
- BIS 12021 - Specification for control transformer
- BIS 8623 - Factory built assembly of switchgear & control gear
- BIS 13947 (Part I) - Degree of protection for enclosure
- BIS 3842 - Specification for electrical relays for AC system
- BIS 13707 - Specification for HRC fuses
- BIS 5082 - Wrought Al. and Aluminium alloys, bars, rods, tube and sections for electrical purposes
- BIS 13947 (Part 1) - General requirement for switchgear & control gear for voltage not exceeding 1000V
- BIS 3231 - Electrical relays for power system protection

Motor Control Centre / Ventilation Sub-Panel

Motor control centre shall be floor mounted extendable type bolted construction &

Ventilation sub-panel shall be wall mounted type. The sheet steel (CRCA) used for fabrication shall be of 2.0mm for load bearing members and 1.6mm for non-load bearing members. The panels shall be supplied with required base channels. These panels shall be cubical sectionalized type, totally enclosed dust & vermin proof. Gaskets shall be provided in all joints to prevent dust to reach the internals of the panels to make it completely dust proof. The degree of protections for panels shall be IP 52 for indoor applications and IP 65 for outdoor applications as per IS: 2147.

These panel (MV) shall be suitable for voltages up to 500 volts, three phase 50 Hz, 4 wire supply capable of functioning satisfactorily in temperature ranging up to 45 to 50 degree centigrade and rupturing capacity suitable for connected load & design should be type tested for 42 KA fault level. All joints of panels shall be welded and braced as necessary to provide a rigid support for all components. The base channel provided in the floor mounted MV panel shall be 100mm x 50mm x 6mm & a clear space of 200mm between the floor and the bottom most part of the unit shall be provided. The panel shall be correctly positioned. Self-threading screws shall not be used in the construction of control panels. Appropriate knock-out holes of proper sizes shall be provided for incoming and outgoing cables. The facility for bottom or top entry of cables in the panels shall be provided. Necessary cables clamps shall be provided for holding the cables in position.

All power/control wiring inside the panel shall be colour coded and control wiring ferruled for identification purpose. All labeling shall be provided in engraved anodized aluminum strips on the front face of the panel.

Each circuit breaker shall be housed in separate compartments. It shall have steel sheets on top and bottom of compartment. The steel sheet hinged door shall be interlocked with the circuit breaker on the “ON” position. When the breaker is on the “ON” position, suitable preventive measures shall be provided, such as interlocks, to prevent the breaker from being drawn out. When the breaker is in “ON” position steel sheet shall be provided between the tiers in the vertical section. The door of this compartment shall not form part of the draw out arrangements.

Bus-Bars

The bus-bar and its connections shall be aluminum Electrolytic grade E-91 as per IS: 5082 and shall be of rectangular section. These should be suitable for full load current for phase bus-bar and neutral bus-bar shall be of half rated current capacity. The bus-bar should have provision on either side for extension. The bus-bar should be sleeved with colour coded heat shrinkable PVC sleeve. Bus-bar supports shall be of fibre glass reinforced thermosetting polyester having in built and tracking barriers to break the path of conducting dust through moulded ribs.

In panels bus-bar connections shall be done by drilling holes with cadmium coated bolts and nuts. Extra cross section shall be provided to compensate drilling of the holes. Insulated aluminum strips of suitable size of full rated current capacity shall be used for

interconnecting bus-bar and breaker.

A horizontal / vertical wire way shall be provided for interconnecting control wiring between different vertical sections.

The terminal blocks shall be used for outgoing terminals and neutral link at a suitable located place in the control panel. Separate compartments for outgoing and incoming cable shall be provided. The current transformers of allinstruments shall be mounted with terminal blocks.

All live parts including incoming and outgoing link / terminals should be totally shrouded by means of non-hygroscopic and fire retardant material.

Air Circuit Breakers

The circuit breaker shall be capable of making and breaking the specified fault currents without straining or damaging any part of the switchgear. The breakers shall be air break, motorized / manually operated as specified in BOQ and draw out type. All feeders of rating 800A and above shall be ACB and of fully draw out type. The circuit breaker shall be stored energy closing type, manual/electrically operated with tripping mechanism. The circuit breaker shall be provided with 4 NO + 4 NC of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block. Circuit breakers with stored energy closing mechanism shall be capable of making the rated short-circuit current, when the stored energy is suitably charged by a spring. It shall also be capable of closing on no-load without suffering undue mechanical deterioration. The maximum make- time shall also not be exceeded.

The direction of motion of the handle, for manual spring charging shall be marked. A device indicating when the spring is charged fully shall also be provided. Motors and their electrically operated auxiliary equipment for charging a spring shall operate satisfactorily between 85% and 110% of the rated supply voltage. The breaker operating mechanism should store energy for O-C-O operation and shall not, in any case, get stuck in closed position during this cycle. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible. The breaker operating mechanism shall be electrically and mechanically trip-free in all positions.

All ACBs shall be provided with microprocessor based trip unit for protection against overload, short circuit and earth faults. The releases shall be communicable to other systems on an open communication protocol. The Communication Port shall be provided in front/back. The circuit breakers shall be suitable for locking in fully isolated condition.

Following interlocks and features shall be provided so that

Truck can be moved within panel only when CB is off.

CB can be closed only when the test (or) service limit switches permits.

Breaker Compartment door cannot be opened when the CB is in Service/test position.

Breaker cannot be put in to service position with compartment door open.

Earth slide beyond the test position till trolley is drawn out.

Closing and tripping coil shall operate satisfactorily under the following conditions of supply voltage variation.

Closing coils – 85% to 110% of rated voltage.

Trip coils – 70% to 110% of rated voltage.

Moulded Case Circuit Breakers

The MCCBs shall confirm to the latest applicable standards. MCCBs in AC circuits shall be of four pole construction arranged for simultaneous four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator. Operating handle for operating MCCBs from door of board shall be provided. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings. MCCBs shall incorporate time delay devices to ensure that it will tolerate harmless transient overload unless this is well in excess of 25% of its rated value for a sustained period. The circuit breaker shall be provided with 2 NO + 2 NC of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block. The breaking capacity of MCCB's shall be as per the design requirements.

Miniature Circuit Breakers

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 230/415 VAC 50 Hz applications with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting be type (Class-3). MCBs shall be classified (B, C, D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar.

Rotary Switch / Selector Switch / Switches / HRC Fuses / Starters / Single Phase Preventers / Toggle Switch

These shall be of approved make and conforming to relevant ISI standard. The rupturing capacity of HRC fuses should not less than 80 KA and in case of switches it should be 60 Amps maximum.

Current Transformer

The current transformers shall have accuracy of class I and 5P10 / 10P10 and suitable VA burden for operation of the connected meters and relays.

Overload Relays

All the motors shall have overload relay protections conforming to relevant IS.

Time Delay Relays

These shall be adjustable type with time delay adjustments of 0-180 or as per manufacturer standards.

Indicating Lamps and Metering

These shall confirm to BS37 & BS39. All meters shall be flush mounted and draw-out type. The indicating lamp shall be filament type and with very low burden & economy resistor.

Voltmeter and Ammeters

Motor Control Centre (MV Panel) shall have flush type voltmeter & ammeter of size 96 x 96 mm.

Push Button Stations

These shall be suitable for panel mounting and accessible from front without opening. These shall be provided for manual starting and stopping of motors/equipments as per normal practices. The contacts shall be suitable for 6AMP current capacity.

Name Plate

Suitable anodized Aluminium name plate of 1.2 mm thick shall be provided on all the Switchboards and individual compartments.

Conduits

These shall be preferable made of mild steel, stove enameled from inside and outside with minimum wall thickness of 1.6 mm for conduits up to dia of 25mm and 2 mm for conduits above 25 mm diameter.

Cables

Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

The cables shall comply with the latest edition of the following standards

- BIS: 7098 (PART-I) - XLPE Cables - LT
- BIS: 8130 - Conductors for insulated electric cables & flexible cords.
- BIS: 3975 - Mild steel wires, strips & tapes for armouring of cables.
- BIS: 10418 - Wooden drums for electric cables.
- BIS: 10810 (PART 58) - Oxygen Index test

The material of cable shall be as follows:-

The MV power cable of 660/1100 V. grade shall be XLPE insulated Aluminium conductor armoured cable.

The MV control cables shall be PVC insulated copper conductorarmoured stranded cable.

The HT power cable of 415 V grade shall be XLPE insulated Aluminium conductor armoured cable.

Laying Of Cables

These shall be laid as Indian Standard code of practice. All cables shall be laid on 16G GI Perforated U shaped Channel 40mm x 20mm cable trays. In case more than one cable is running, then proper space in between the two cables shall be provided to avoid loss of current carrying capacity. While cables are running on walls, proper saddles must be provided.

Wire Sizes

Single stand PVC-copper conductor wires shall be used inside the control panel for interconnecting different components. All wires shall be neatly dressed and coloured beads shall be provided for easy identification in control wiring. The minimum size of control wiring shall be 1.5sq.mm. Testing of panels as per code of practice shall be done at works by Employer / Architect before inspection & dispatch to site.

Drawings

Necessary drawings of all control panels and wiring of equipment etc., shall be submitted by the contractor for approval of the Engineer in Charge. On final completion of job and before handing over of AC System As Built Drawings shall be submitted to the Department.

Testing

All equipment and components supplied may be subjected to inspection and tests by the client / consultant or his authorized representatives during manufacture, erection / installation and after completion. No tolerances shall be allowed other than the tolerances specified or permitted in the relevant approved Standards, unless otherwise stated. If the guaranteed performance of any item of equipment is not met and / or if any item fails to comply with the

specification requirement in any respect whatsoever at any stage of manufacture, test or erection, the client / consultant may reject the item, or defective component thereof, whichever he considers necessary.

The complete electrical installation shall be tested in accordance with relevant IS codes in presence of Electrical Supervisor of the client before commissioning of plant.

Painting of Panels

All sheet metal enclosures shall be powder coated only after de-rusting & hot- dip phosphating degreasing etc. at works only.

NOTE: Rubber mats of 1100 volts shall be laid in front of all switch boards.

Sizes of Power Cabling

The following size of power cabling shall be used only:

	HP of Motors	**Cable size**
a)	Up to 5 HP	3c x 4sq.mm aluminium conductor armoured cable.
b)	5 to 7.5 HP	3c x 6sq.mm aluminium conductor armoured cable.
c)	10 to 15 HP	2no. 3c x 6sq.mm aluminum conductor armoured cable.
d)	20 to 25 HP	2 Nos.,. 3 x 16sq.mm aluminum conductor armouredcable.
e)	30 to 35 HP	2 Nos.,. 3c x 25sq.mm aluminum conductor armouredcable.
f)	40 to 50 HP	2 Nos.,. 3c x 35sq.mm aluminum conductor armouredcable.
g)	60 HP	2 Nos.,. 3c x 50sq.mm aluminum conductor armouredcable.
h)	75 HP	2 Nos.,. 3cx 70sq.mm aluminum conductor armouredcable.
i)	100 HP	2 Nos.,. 3cx 95sq.mm aluminum conductor armouredcable.
j)	125 HP	2 Nos.,. 3cx 120sq.mm aluminum conductor armouredcable.

Capacity of Relays and Contacts

The following capacity relays and contacts shall be used for various rating of motors:

Type of Starter Contactor Overload Relay

Contactor Phase Relay Range

a)	50/60 HP Motor	Star Delta Starter	70 Amp.	30 - 50 Amp.
b)	40 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
c)	30 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
d)	25 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
e)	20 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
f)	15 HP Motor	Star Delta Starter	25 Amp.	9-15 Amp.
g)	10 HP Motor	Star Delta Starter	16 Amp.	6-10 Amp.
h)	7.5 HP Motor	D.O.L. Starter	16 Amp.	9-15 Amp.
i)	5 HP Motor	D.O.L. Starter	16 Amp	6-10 Amp.

Earthing

The earthing of all equipments shall be carried out by Copper strips / wires as mentioned in Bill of Quantities. All panels / three phase motors shall be earthed with two number distinct and independent Copper strips / wires of the following sizes:

1.	Motor up to 5.5 KW Wire	3 sq. mm Copper Wire	4 mm dia GI
2.	Motor 7.5 to 18.75 KW Wire	4 sq. mm Copper Wire	6 mm dia GI
3.	Motor 18.75 to 50 KW Strip	25x3 mm Copper Strip	25x6 mm GI
4.	Motor 51 to 89 KW Strip	25x6 mm Copper Strip	32x6 mm GI

The earthing connections shall be connected to main earth station or main earth grid. The earth connections shall be connected to equipments after removal of paint, grease etc.

SERVICES SPECIFICATION

6.10 AIR DISTRIBUTION

Scope of Works

The scope of this section comprises supply, fabrication, installation & testing of all sheet metal GI ducts as well as supply, installation, testing & balancing of all grills, diffusers & other accessories in accordance with thesespecification & Schedule of Quantities.

GI Duct (Site Fabricated)

All ducts shall be fabricated either from Galvanized Sheet Steel (GSS) conforming to IS: 277 or aluminum sheets conforming to IS: 737. The steel sheets shall be hot dip galvanized with coating of minimum 120 grams per square meter (GSM) of Zinc.

The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

Longest side (mm)	Minimum sheet thickness	
	For GSS	For Aluminum
750 mm and below	0.63	0.80
751 mm to 1500 mm	0.80	1.00
1501 mm to 2250 mm	1.00	1.50
2251 mm & above	1.25	1.80

All sheet metal connections, partitions and plenums required for flow of air through the filters, fans etc. shall be at least 1.25 mm thick galvanized steel sheets, in case of G.I. sheet ducting or 1.8 mm thick aluminium sheet, in case of aluminium sheet ducting and shall be stiffened with 25 mm × 25 mm × 3 mm angle iron braces.

Circular ducts, where provided shall be of thickness as specified in IS: 655 as amended up to date.

Associated Items for Duct

Jet nozzles/Eye ball suitable for long throw distance with optimum acoustic properties, preferably used for heating and cooling in critical areas. The adjustment facilities – manual or automatic. The adjustment can be rotated through 360^0. The material of eye ball is aluminium and mounting for the eyeball is with two plastic rings colour white. The connection element and saddle connection are in galvanized sheet steel. The surface can be pre- treated and powder coated.

Supply/return air outlets F.A. grilles and accessories shall be constructed from extruded aluminium sections.

Flanges for matching duct sections, stiffening angels (braces) and supporting angles shall be of rolled steel sections, and shall be of the following sizes.

Application	Duct Width	Angle Size
Flanges	Up to 1000 mm	35mm × 35mm × 3mm
-do-	1001 mm to 2250 mm	40mm × 40mm × 3mm
-do-	More than 2250 mm	50mm × 50mm × 3mm
Bracings	Up to 1000 mm	25mm × 25mm × 3mm
-do-	More than 1000 mm	40mm × 40mm × 3mm
Support angels	Up to 1000 mm	40mm × 40mm × 3mm
-do-	1001 mm to 2250 mm	40mm × 40mm × 3mm
-do-	More than 2250 mm	Size and type of RS section shall be decided in individual cases

Hanger rods shall be of mild steel and of at least 10 mm dia for ducts up to 2250 mm size, and 12 mm dia for larger sizes. All ducts shall be supported from the ceiling / slab by means of MS rods of dia (10-12) mm fully threaded with MS angle at the bottom with neoprene pad in between the duct & MS angle. The ducts shall be suspended from the ceiling with the help of dash fasteners. The contractor shall arrange provision for necessary ancillary materials required for hanging the ducts. **Alternatively Steel Wire Rope Hangers & Supports system can be used in place of MS Rod & MS Angle.**

All nuts, bolts and washers shall be zinc plated steel. All rivets shall be galvanized or shall be made of magnesium – aluminium alloy. Self-tapping screws shall not be used.

The vanes shall be provided wherever required and shall be securely fastened to prevent noise & vibration.

The rubber gasket shall be installed between duct flanges in all connections and joints.

All flanges and supports should be primer coated.

The flexible joints shall be fitted to the delivery side of AHU fans with Fire Retardant Double canvass. The length of flexible joints should not be less than 150 mm and not more than 300 mm between faces.

The ducting work can be modified if deemed necessary in consultation with the Engineer in Charge to suit actual site conditions in the building.

Construction of Duct

Ducts shall be fabricated at site or factory fabricated and shall be generally as per IS: 655

"Specifications for metal air ducts". Unless otherwise deviated in these General Specifications.

The interior surfaces of the ducting shall be smooth.

All the ducts up to 600 mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600 mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300 mm center for ducts Up to 600 longest side, and 100 mm center for ducts above 600 mm size shall be provided for stiffening.

As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.

Flanged joints shall be used at intervals not exceeding 2500mm. Flanged shall be welded at corners first and then riveted to the duct.

Stiffening angels shall be fixed to the sides of the ducts by riveting at 1.25 meters from joints for ducts of size 600 mm to 1500 mm, and 0.6 mm form joints for ducts of size larger than 1500mm. Bracings for ducts larger than 1500mm can alternatively be by diagonal angels.

Plenums for filters shall be complete with suitable access door of size 450mm × 450mm.

Box Type Dampers & Splitters

These dampers shall be provided in the ducting work for proper control and balancing of air distribution. All dampers shall be louver type robust construction. These dampers shall be fitted with easily accessible operating mechanism, complete with links, levers, quadrant for proper control and setting in a desired position. The position of the handle of the damper operating mechanism shall be clearly visible and shall indicate the position of the damper in the duct. All dampers, splitters shall be fabricated out of G.S. sheet of two gauges higher than the duct piece having these fittings. Dampers shall be installed in duct at all required locations. No extra payment shall be made separately since these form part of Air Circulation System.

NOTE: In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the contractor shall support the ducts with M.S flats of at least double the thickness of the angle iron supports.

Supply / Return Air Grills & Ceiling Diffusers

Grilles and diffuser constructed of extruded aluminium sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grills and diffusers shall have a rear set of adjustable

blades, perpendicular to the face blades for deflection purpose.

All grills / diffusers shall have soft continuous rubber / foam gasket between the periphery of the grills / diffusers and surface on which it has to be mounted. The colour of grills / diffuser shall be as per the approval of the Engineer in Charge.

Rectangular / Square / Linear Supply and Return Grills

Square and rectangular wall outlets shall have a flanged frame with the outside edges retuned or curved 5 to 7 mm and fifed with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give Upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shooter side to achieve horizontal spread air pattern to at least 45 degrees. Fixed bar linear air grills shall have only front louvers. The outer framework to the grills shall be made of not less than 1.6 mm thick aluminium sheet. The louvers shall be of aerofoil design of extruded aluminium section with minimum thickness of 0.8 mm at front and shall be made of 0.8 mm thick aluminium sheet. Louvers may be spaced 18 mm apart.

Square / Rectangular Ceiling Diffusers

Square and rectangular ceiling air diffusers shall have a flanged flush with the ceiling into which it is fitted or shall be of anti-smudge type the outlets shall comprise and outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6mm thick extruded section aluminium sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminium section.

Circular Ceiling Diffusers

Circular ceiling diffusers shall have either flush or anti-smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti-smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

Linear Slot Diffusers

Linear diffuser shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminium sheet.

Laminar Supply Air Diffusers

Laminar supply air diffusers shall be made of 2 mm thick powder coated aluminum sheet duly insulated with 5 mm thick closed cell polyethylene foam insulation having factory laminated aluminium foil and joints covered with self-adhesive aluminium taps and having holes 2/3 mm dia including frame work.

Volume Control Device

All supply air outlets shall be fitted with a volume control device, made of extruded aluminium gate section. The blades of the device shall be mill finish/block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied spaces without removing any access panel. The volume control device for circular outlets shall be opposed blade radial/shutter type dampers, or two or more butterfly dampers in conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/wall outlets and intakes.

Fresh Air Intake Louvers with Bird Screen

The fresh air intake louvers at least 50mm deep will be made of powder coated extruded aluminum construction. A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens. The blades shall be inclined at 45 degree on a 40mm blade pitch to minimize water ingress. The lowest blade of the assembly shall be extended out slightly to facilitate disposal of rain water without falling on door / wall on which it is mounted. Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/vibrating of the louvers, at not more than 750mm centres where the louver's length in longer than 750mm.

The intake louvers shall be provided with factory fitted volume control dampers in black finish.

Painting

All ducts collar / shoot behind the grills / diffuser shall be given at least two coats oil black enamel paints.

Testing

The complete duct system shall be tested for air leakage & complete air distribution system shall be balanced in accordance with air quantities indicated on the approved drawing.

Factory Fabricated Ducting

General

Ducting work shall mean all ducts, casing, dampers, access doors, joints, stiffeners and hangers.

Governing Standards

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA – 1995 standards ("HVAC Duct Construction Standards – Metal and Flexible – Second Edition – 1995" – SMACNA).

Duct Materials

The duct shall be fabricated from Lock Forming Quality (LFQ) grade galvanized steel sheets with 120 gm / square m galvanizing (total coating on bothsides) on the sheets.

All ducts wherever specified, shall be factory fabricated in L sections from G.I. continuous coils with all suitable joints, supports, sealing arrangements etc.

The thickness of galvanized sheet and type of flange class at 1200 mm spacing shall be as follows:-

Size of Duct	Sheet Thickness	Type of Flange
Up to 450 mm	0.63 mm	C&S cleats
450 mm to 750 mm	0.63 mm	Type E
751 mm to 1000 mm	0.80 mm	Type E
1001 mm to 1500 mm	0.80 mm	Type H
1501 mm to 1800 mm	1.00 mm	Type H
1801 mm to 2250 mm	1.00 mm	Type J
2251 mm and above	1.25 mm	Type J

The gauges, joints and bracings for sheet metal ducting work shall further conform to the provision as shown on the drawings.

Ducts larger than 600 mm shall be cross broken or straight beaded. Duct sections up to 1200 mm length may be used with bracing angles omitted.

Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the engineer – In – Charge.

All ducts shall be supported from the ceiling / slab by means of fully threaded GI rods of 8 mm – 12 mm dia, with M.S. slotted double – C channel of 3.0 mm thickness at the bottom. The rods shall be anchored to R.C. slab usingmetallic expansion fasteners.

Installation

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.

Great care should be taken to ensure that the ducting work does not extend outside and beyond height limits as noted on the drawings.

All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

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

All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise of vibration.

The ducting work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the engineer – In – Charge. The contractor shall verify all measurements at site and shall notify the engineer – In – Charge. The contractor shall verify all measurements at site and shall notify the engineer – In – Charge of any difficulty in carrying out his work before fabrication.

Self-adhesive sponge rubber / PVC gaskets of 6 mm maximum thickness shall be installed between duct flanges as well as between all connection of sheet metal ducts to walls, floor column, heater casing and filter casings. Sheet metal connections shall be made to walls and floor by means of wooden member anchored to the building structure with anchor bolts and withthe sheet screwed to them.

Flanges, bracing and supports shall be galvanized steel. The connection shall be 4 bolts slip on type flange system with sealant injected within the flanges. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

Joints, seams, sleeves, splitter, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineers –in –Charge.

Hexagon nuts and bolts, stove bolts or buck bolts, rivets, or closed center top rivets, or spot welding may fix joints requiring bolting or riveting. Self-tapping screws must not be used .All jointing materials must have a finish such as cadmium plating or galvanized as appropriate.

Fires retarding non- porous, vermin proof flexible joints are to be fitted to the suction and delivery of fans. The material is to be normally double heavy canvas or as directed by Engineer-in-Charge .On all circular spigots the flexible materials are to be screws or clip band

with adjacent screws or toggle fitting. For rectangular ducts the material is to flanged and bolted with a backing flat or bolted to mating flange with backing flat.

The flexible joints are to not less than 75 MM and not more than 250 MM between faces.

The duct work should be carried out in a manner and at such times as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

Duct passing through brick or masonry, wooden frames work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

Dampers

Splitter Dampers

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

The dampers shall be of an approved type, lever operated and complete with locking devices, which will permit the dampers to be adjusted and locked in any positions, and clearly indicating the damper position.

The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 mm (18) Gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm. Angle shall not interfere with the operation of dampers, nor cause any turbulence.

Opposed Blade Dampers

Automatic and manual volume opposed blade dampers shall be complete with frames and nylon bush as per drawings. Dampers and frames shall be constructed of 1.6 mm steel sheets and blades shall be of extruded aluminium of aerofoil design. The dampers for fresh air inlet shall additionally be Provided with fly mesh screen, on the outside, of 0.8 mm thickness with the mesh.

Wherever required for system balancing, a balancing opposed blade damper with quadrant and thumb screw lock shall be provided.

After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.

Access panel

A hinged and gasketed double skin, factory fabricated access panel measuring at least 450 mm x 450 mm shall be provided on duct work before each fire damper and at each control

device that may be located inside the duct work.

Miscellaneous

All duct work joints are to be true right angle and with all sharp edgesremoved.

Sponge rubber gaskets also to be provided behind the flange of all grilles.

Each chute from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by engineer – In – Charge.

The ducts should be routed directly with a minimum of directional change. All edges shall be machine treated using lock formers, flanges and rollers.

All the flanges shall be connected to the GSS ducts by rivers at 100 mmcenters.

The ducts should be supported by approved type supports at a distance not exceeding 2.0 meters

Steel Wire Rope Hangers & Supports

Wire Hangers shall be used to suspend all static HVAC & Mechanicalservices.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking lock at the other end comprising of a single piece housing; the wedge inside the lock housing should be having serrated teeth & made up of sintered steel and springs used, if any, should be made up of stainless-steel. Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip for safety purpose. Only wire and/or supports supplied and/or approved, shall be used with thesystem.

Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension

systems.

Wire rope should be manufactured to BSEN 12385: 2002

The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer's handbook.

The contractor shall select the correct length of wire rope required to support the service.

Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

Table. 1

Wire Hanger Safe Working Load		
Hanger No.	**minimum breaking load of Wire Rope**	**working load limit (kg/lbs.)**
No. 1	80kg/176 lbs.	0-10 kg / 0-22 lbs.
No. 2	260kg/572 lbs.	10-45 kg / 23-100 lbs.
No. 3	580kg/1276 lbs.	45-90 kg / 101-200 lbs.
No. 4	1500kg/3300 lbs.	90-225 kg / 210-495 lbs.
No. 5	2160kg/4752 lbs.	225-325 kg / 496-715 lbs.
No. 6	2500kg/5500 lbs.	325-500 kg / 715-1100 lbs.

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. Comply with manufacturer's load ratings and recommended installation procedures. Note the testing is done to the minimum breaking load of the wire thus giving a minimum safety factor of 5:1.

Mechanical Supports – Wire Hanger Supports are suitable for: Water Pipes, Drainage Pipes, Gas Pipes, Refrigeration Pipes, and Condensation Water Pipes.

Piping Supports: Rigid supports may be used in conjunction with wire hangers to assist with alignment of services as per the Schedule. These can be at 30m intervals or so depending on the run of the service. Rigid support must also be used in conjunction with wire hangers with pipe work at each change of direction or connection. For insulated pipe, provide protective sleeve to protect the entire circumference of the pipe insulation. Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.

Any other wire hanging arrangement solution can be used based on manufacturer's recommendation on site conditions after prior approval. Support piping in accordance with Schedule at the end of this Section.

Refer to manufacturers catalogue and installation guide for further technical information. Comply with manufacturer's load ratings and recommended installation procedures. All supporting system shall be provided by samemanufacturer.

Pipe Hanger Schedule

Pipe Size	**Weight of pipe + fluid**	**Weight of pipe + fluid per Rmt**	**Spacings (pipe + fluid + insulation)**	**Spacings (pipe + fluid + Laster)**	**Total Weight of pipe + fluid**	**Total Weight of pipe +fluid**	**Wire Hanger (SWL kgs)**	**Wire Hanger (SWL kgs)**
(mm)	with insulation (kgs / rmts)	with sand cement plaster (kgs / rmts)	between supports (mts)	between supports (mts)	with insulation(kgs / rmts)	with sand cement plaster (kgs / rmts)	for pipe with insulation (kgs / rmts)	for pipe with sand cement plaster (kgs/rmts)
12-32	11.73	14	1.5	1.5	18	21	45	45
40-65	11.73	14	2	2	23	28	45	45
80-125	34.73	41.67	2	2	69	83.34	90	90
150-200	112	134	2	1.5	224	201	225	225
250-above	as per the manufacturer recommendation and with prior approval.							

Rigid Supports for pipes to be used in conjunction with wire supports:

Pipe Size(mm)	**Rod Size(mm)**
Dia.	
Up to 12 mm	10
15-25 mm	10

25-65 mm	10
80-100 mm	12

Pipe Size (mm)	**Pipe Supports**
UP TO 50 Ø	40×40×6 M.SANGLE
80Ø TO 100Ø	50×50×6 M.SANGLE

Pipe Size (mm)	**Horizontal Supports**	**Vertical Supports**
125Ø TO 200Ø	75×40 M.S CHANNEL	50×50×6 M.S ANGLE
250Ø TO 300Ø	100×50 M.S CHANNEL	75×40 M.S CHANNEL
300Ø TO 400Ø	150×75 M.S CHANNEL	100×50 M.S CHANNEL
450Ø TO 600Ø	200×75 M.S CHANNEL	200×75 M.S CHANNEL

Testing

a. During construction, the contractor shall properly cap all lines, so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed

Thoroughly after completion (for the purpose of removing dirt, grit, sand etc. from the piping and fittings) for as long a time as is required to thoroughly clean the system.

b. All piping shall be tested to hydrostatic test pressure of at least two times the maximum operating pressure, but not less than 10 kg per sq. cm gage for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified, retested and gotten approved

c. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

d. Piping may be tested in sections and such sections shall be securely capped, then retested for the entire system.

e. The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Owner's site representative.

f. The contractors shall provide temporary pipe connections to initially by-pass condenser / chiller and circulate water through condenser/ chilled water pipe lines for minimum 8 hours. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.

g. After regular flushing, as per 'f' above, all systems shall be chemically cleaned.

Chemical cleaning shall be carried out in 3 stages. In first stage biological cleaning shall be done to remove algae, bacteria, SRB etc which produces slimes. Second stage is pre-cleaning in which loose rust, oil, and debris are removed. Chemical addition and hold up time shall be as per chemical supply agencies recommendations. Third stage is passivation, in which chemicals will be added and passivation film will be formed over inside surfaces of piping system. Type of chemical used and quantity of the same along with detailed method statement shall be submitted by contractor for consultants' approval before starting this activity.

Before handover Owner's site representative shall be provided with certificate of cleaning of pipe systems, signed by the contractor.

h. After the piping has been installed, tested and run for at least three days of eight hours each, all insulated exposed piping in plant room shall be given two finish coats, 3 mils each of approved colour, conforming to relevant BISCodes.

The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to Insulation section.

i. The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system Concerned. If proper circulation is not achieved due to air bound connection, the Contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and re-finishing of floors and walls if required.

j. The Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test and to remove water resulting from cleaning and after testing.

Fire Dampers (UL Listed & Certified)

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of fire dampers conforming to these specifications and inaccordance with Schedule of Quantities.

Motorized Combined Smoke & Fire Dampers - Spring Return Type

All supply air Ducts in AHU room crossing shall be provided with approved make fire and smoke dampers of at least 90 minutes fire rating & shall be UL certified as per UL555.

The fire damper blades & outer frame shall be formed of 1.6 mm galvanized steel sheet. The damper blade shall be pivoted on both ends using chrome-plated spindles in self-lubricating bushes. Stop seals shall be provided on top & bottom of the damper housing made of 16G Galvanized steel sheet. For preventing smoke leakage side seals will be provided.

In normal operating conditions damper blade shall be held in open position with the help of a 24 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.

The damper shall be actuated through electric actuator. The actuator shall be energized with the help of a signal from smoke detector installed in AHU Room / R. A. Duct. The fire damper shall close due to temperature rise in S. A. Ducts through the electric temperature sensor, which is factory set at 165 °F.

Each motorized smoke cum fire damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from UPS or emergency power supply to show status of the damper (open or close), to allow remote testing of damper, indication in event of damper closure due to signal from smoke sensor / temp. Sensor & reset button. Additional terminal will be provided to have audio cum video signal in Central Control Room.

Damper actuator shall be such that it should close the damper in the event of power failure automatically and open in the same in case of Power being restored.

The fire Damper shall be mounted in fire rated wall with a duct sleeve 600 MM long. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of GI Sheet shall be 18G.

The damper shall be installed in accordance with the installation method recommended by the manufacturer.

Hinged access doors of suitable size complete with airtight gaskets shall be provided in all fire dampers & plenums.

Insulation / Lining Work

Scope of Works

The scope of this section comprises supply & fixing of thermal / acoustic insulation of ducts, pipes etc. as per the specification given below & in accordance with Schedule of Quantities.

Material & Process of Acoustic Insulation of Duct / AHU Room

Resin Bonded Fiber Glass Wool

The Thermal conductivity values in W/m.K of fiber glass shall confirm to following:

Mean Temperature ^{0}C		**Density In Kg / Cmt.**	**Thermal Conductivity W/m.k**
P	P		
	25^0C	32/48	0.030

P P

Acoustic Lining of Duct

The material to be used for duct lining shall be 12 / 25 mm thick resin bonded fibre glass rigid board having a density of 48 Kg/m³ & covered with 0.5 mm thick perforated aluminum sheet. The lining of initial length of the duct shall be done as shown in the tender layout drawings & shall be carried out as follows.

a) Clean the duct piece thoroughly,

b) Fix the board of suitable thickness inside the duct & cover with fibre glass tissue paper.

c) Cover the insulation board with 0.5mm thick perforated aluminum sheet with atleast 20% perforation.

d) Secure the insulation board & aluminum sheet with cadmium coated bolts nuts & cup washers / steel screws.

f) Finally seal the ends completely, so that no lining material is exposed.

Acoustic Lining of AHU Room

The four walls and ceiling of AHU Rooms shall be provided with acoustic lining of thermal insulation as per following specifications & as specified in the Schedule of Quantities.

a) Clean the surface.

b) A 610 x 610 mm frame work of 25 x 50 x 50 x 50 x 25 mm 'U' shape channel made of 0.6 mm. thick G.S.S. shall be fixed on to walls by Means of rawl plug in walls & dash fasteners in ceiling. Before fixing channel shall be filled with fibre glass.

c) Fix the resin bonded glass wool having density of 32 Kg/cmt.in the frame.

d) Finally, finish it by covering the surface with 0.5 mm thick perforated aluminium sheet with brass screws. Before fixing aluminium sheet, fibre glass tissue paper must be sandwiched.

e) All horizontal and vertical joints shall be covered with at least 25 mm. wide, 1mm aluminium strips held in position by steel or brass screws.

Material & Process of Thermal Insulation of Refrigerant Piping & Duct

- **REFRIGERATION PIPE INSULATION:**

❖ **QUALITY ASSURANCE**

Insulation shall be a flexible, closed –cell polyolefin pipe insulation. The insulation must

conform

To (ASTM) C 1427

Insulation materials shall have a closed cell structure to prevent moisture from wicking which makes it an efficient insulation.

Insulation materials shall be manufactured without the use of CFC's, HFC's or HCFC's or HCFC's. It is also formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.

Insulation materials shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested in accordance with ASTM E 84. In addition, the products, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive.

Insulation materials shall have a maximum water vapor transmission of 0.08 per inches when tested in accordance with ASTM E 96, Procedure A.

The insulation to be used shall conform to the following specifications.

- ✓ Density : 45 Kg/cum
- ✓ K Value : Not more than 0.032 W/m Deg K at 23 deg C mean Temperature Fire Properties
- ✓ BS 476 part 6 & 7 : Class 0
- ✓ Fire Propagation Index : Less than 12
- ✓ Surface Spread of Flame : Class 1
- ✓ Smoke Density & Toxicity : To comply with ISO 5659 -2

- **APPLICATION**

  All liquid and suction lines shall be insulated continuously from the indoor unit to the outdoor unit

  All low temperature lines shall be insulated with a minimum of 25mm wall thickness or as specified in the BOQ.

- **INSTALLATION**

- ✓ All refrigerant copper lines must be free of extraneous chemicals such as corrosive cleaners or building materials
- ✓ Refrigerant pipe shall be sealed while slipping on insulation to prevent foreign matter from entering the tube.
- ✓ Insulation is to be slid onto pipe; longitudinal slitting of the insulation is not allowed expect on mitered sections. Insulation shall be pushed onto pipe, not pulled.

- ✓ Insulation shall be mitered, pre adhered and longitudinally slit inside throat to fit over all p-traps, tees and elbows or bends over 90^0.
- ✓ All butt joints and mitered seams shall be adhered with full coverage of adhesive on both surfaces. Insulation shall not be stretched when adhering.
- ✓ Insulation must be installed in an adequately ventilated area. It may be necessary to increase insulation thickness if adequate ventilation is not present.
- ✓ At the beginning, at every 12 to 18 feet, and at the ends of piping runs, the insulation shall be adhered directly to the copper using a 2" strip of adhesive. Insulation should not be adhered to the pipe at the extreme low points in any piping run.
- ✓ Saddles shall be installed under all insulated lines at locations where insulation may be compressed.
- ✓ Reputed make insulation pipe hangers can be installed at the compression locations and the seams shall be sealed with manufacture recommended contact adhesive.
- ✓ Wood dowels or blocks, of a thickness equal to the insulation, can be inserted and must be completely sealed into the insulation at the saddle locations. All seams shall be sealed with manufacture recommended contact adhesive.
- ✓ Hangers clamped directly to the pipe shall be insulated over the hanger; insulation shall be fully adhered to the hanger. In addition, hangers with double rods shall be insulated between the rods. All seams of the insulation shall be sealed with adhesive.
- ✓ All insulation exposed to sunlight or installed outdoors shall be protected with two coats of weather resistant coating and as specified in the BOQ.

➢ **INSULATIONS**

- **GENERAL**

The scope of this section covers the supply, installation, testing and commissioning of the insulation for chilled water piping, condensate drain piping, refrigerant piping, expansion tanks, sheet metal ducting, walls, ceilings & floors of AHU rooms, sheet metal ducting, acoustic lining for supply air ducting etc.

INSULATION MATERIAL: The material to be used for insulation purpose shall be as under:

Item to be insulated	**Material to be used**
Condensate Drain Piping, Refrigerant Piping, Ceiling and Floors etc.,	Closed Cell Elastomeric Nitrile Butadiene Rubber.

- ✓ Insulation material shall have **Micro ban anti-microbial** product protection. The antimicrobial product protection shall be an integral part of insulation that is built-in during the manufacturing process and the product protection should not allow the microbes to function, grow and reproduce.

- ✓ Resistance towards microbiological growth on insulation surface should confirm to following standards: Fungi Resistance – ASTM G21 and Bacterial resistance – ASTM E 2180.
- ✓ Thermal conductivity of Elastomeric Nitrile rubber shall not exceed **0.035 W/m°K** at an average temperature of 20°C.
- ✓ The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990.
- ✓ Water vapour permeability shall not exceed **1.74 x 10^{-14} Kg/m.s.Pa,** i.e. Moisture Diffusion Resistance Factor or **'μ' value should be minimum 10,000**
- ✓ **Density** of Material shall be between **45 to 60 Kg/m^3**

- **PIPING INSULATION**

All chilled water, refrigerant and condensate drain pipe shall be insulated in the manner specified herein. An air gap of 25 mm shall be present between adjacent insulation surfaces carrying chilled water or refrigerant. Before applying insulation, all pipes shall be brushed and cleaned. All Pipe surfaces shall be free from dirt, dust, mortar, grease, oil, etc. Nitrile Rubber insulation shall be applied as follows:

- ✓ Insulating material in tube form shall be sleeved on the pipes.
- ✓ On existing piping, slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer.
- ✓ Adhesive must be allowed to tack dry and then press surface firmly together starting from butt ends and working towards centre.
- ✓ Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- ✓ The insulation shall be continuous over the entire run of piping, fittings and valves.
- ✓ All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.
- ✓ The detailed application specifications are as mentioned separately. The manufacturer's trained installer should only be used for installation.

- **RECOMMENDED ADHESIVE**

  In all cases, the manufacturer's recommended Adhesive should be used for the

specified purpose.

- **DUCT THERMAL INSULATION**

  Where ducts are to be insulated the same shall be carried out with the insulation material and thickness as under:

AIR	Location	Thickness- mm	Insulation. Material
Supply	Unconditional Space	30	RPUF
Supply	Conditioned Space	13	Cross linked polyolefin
Return	Unconditioned	19	Cross linked polyolefin

Wherever required, the thermal insulation of ducts shall be carried out as under:

- ✓ The ducts to be insulated shall be cleaned thoroughly and cleaned and specified thickness of XLPE insulation shall be stuck to the duct using cold adhesive @ 1.5 Kg/Sq.m
- ✓ All joints shall be properly sealed with 50 mm wide aluminum tape / 50 mm wide PVC packing tapes.
- ✓ Finally the insulation shall be tired down with 12 mm wide nylon box strapping at 300 mm centers to avoid the box strapping from biting into the insulation and damaging it, 50 mm wide x 100mm long, 24 gauge GI sheet shall be bent into 'L' shape and placed at 4 corners of the ducting between the box strapping and insulation.
- ✓ If any insulated portions of the ducts are visible through the return grilles continuous grilles, the insulation shall be painted with black Matt finish Paint.

- **DUCT THERMAL INSULATION FOR OUTDOOR DUCTS (Cement Plaster):**

Supply Air / Return Air Ducts if running exposed together, they shall be insulated with 50 mm thick expanded polystyrene or 30 mm thick Rigid Polyurethane Slabs as under or as specified in the BOQ.

- ✓ Clean the duct surface and apply two coats of hot bit men @ 1.5 Kg/Sq.mm for two coats.
- ✓ Stick insulation slabs and hold them down with 1mm dia Galvanized steel wire mesh
- ✓ Wrap 500 G Polythene sheets over the above.
- ✓ Hold the Polythene sheets with 12 mm dia x 22 G Galvanized steel wire mesh.
- ✓ Apply 12 mm thick cement plaster 1:3 in two layers of 6mm each and mixed with water proofing compound.

- ✓ Finally, cover the above with one layer of 6 mm thick Tar felt dipped in Hot bitumen. The Tar felt shall be properly tied down on to the insulation. Finally, two coats of bituminous paint shall be applied.

- **DUCT THERMAL INSULATION FOR OUTDOOR DUCTS (Polyshield):**

  Supply Air / Return Air Ducts if running exposed together, they shall be insulated with 30 mm thick Rigid Polyurethane Slabs as under or as specified in the BOQ.

- ✓ Clean the duct surface and apply two coats of hot bitumen @ 1.5 Kg/Sq.mm.
- ✓ Stick insulation slabs and hold them down with 1 mm dia Galvanized Steel wires @ 1000 mm centers and apply a flood coat of bitumen @ 1.5 Kg/Sq.m
- ✓ Wrap 500 G Polythene sheets over the above.
- ✓ Wrap the insulation with Polyshield coated FRP cloth with manufacture recommended adhesive.
- ✓ Apply two coat of fire retardant resin over the above cloth.

- **ACOUSTIC INSULATION**

  Where inside insulation of ducts are specified for acoustic purpose, the insulation shall be carried out as under (Fiber Glass).

- ✓ Clean the inside surface of the duct to be insulated and fix 25 mm thick resin bonded fiber rigid board factory prefaced R P tissue (black color) with a density of 48 Kg/cum.
- ✓ Fix 24 G perforated Aluminum sheet over the insulation with a minimum 3 mm dia. Perforation hole, and fasten down the AI sheet with GI fasteners half round bolt square washers with 2 washers (flat) fixed through the duct sheet metal.
- ✓ The ends of the insulation shall be wrapped back and tucked in, so that bare glass wool is not exposed to air stream.

Where inside insulation of ducts are specified for acoustic purposes, the insulation shall be carried out as under (Elastomeric Nitrile Rubber)

- ✓ Clean the inside surface of the duct to be insulated and fix 15 mm thick Elastomeric Nitrile Rubber open cell foam (black color) with a density of 140 to 180 Kg/cum.
- ✓ The insulation should be cut to the required size and fixed to the inside of GSS duct using manufacturer's recommended cold adhesive.

- **UNDER DECK INSULATION FOR EXPOSED ROOFS**

  The scope of this section comprises the supply and application of Under-deck insulation conforming to these specifications.

- **MATERIAL**

✓ Insulation material shall be Closed Cell Elastomeric Nitrile Rubber

✓ Density of Material shall be between 40 to 60 Kg/m^3

✓ Thermal conductivity of elastomeric Nitrile rubber shall not exceed 0.035 W/m°K at an average temperature of 0°C

✓ The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990

✓ Material should be FM (Factory Mutual), USA approved.

✓ Water vapour permeability shall not exceed 0.017 Per inch (2.48 x 10-14 Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor 'μ' value should be minimum 7000

- **INSTALLATION PROCEDURE**

✓ The ceiling surface shall be cleaned with brush to remove all dirt, cement etc. If surface is uneven it should be made smooth prior to carrying out insulation work.

✓ A layer of SR – 505 adhesive should be applied on the ceiling with the help of brush so that all the pores are filled and surface becomes smooth and allow it to dry.

✓ Allow an additional 5 mm to the total dimensions while cutting Insulation sheet. Ensure you measure the cutting dimensions on the top surface of the insulation sheet. This can be identified by the products markings; "they are always on the top surface. This surface is the one you will see after installation.

✓ All Insulation sheet and ceiling surfaces shall have all-over adhesive coverage. Adhesive should be applied on the side that has no product markings and identification printing. This side is the one that curves inwards.

✓ During installation avoid air bubbles. Always apply pressure while fixing the Insulation sheet, this action will ensure maximum bond strength.

✓ All cut Insulation sheet edges shall be of a "clean cut nature and not cut rough".

✓ All seams and joint shall be sealed with SR 505 adhesive.

✓ Measurement of surface dimensions shall be taken properly to cut closed cell elastomeric rubbers sheets to size with sufficient allowance in dimension. Material shall be fitted under compression and no stretching of material shall be permitted. A thin film of adhesive shall be applied on the ceiling with brush and then on to the back of the insulating material sheet with brush/small piece of sheet metal having smooth edges. When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond. All joints shall be sealed. The adhesive

shall be strictly as recommended by the manufacturer. SR 505 adhesive of Pipeline should be used for all Under-Deck applications.

- ✓ There is no need to make holes for wires etc. as no supporting wires/screws are required.

- ➢ **MEASUREMENT**

  For variable items like sheet metal ducting, insulation, piping works, cabling etc., the following measurement procedure shall be adopted for billing purposes.

- **SHEET METAL DUCTING:**

  Payment for ducting shall be based on the finished external measurement of the duct pieces. The rate per sq.mtr of duct shall be charged for individual gauges of sheet metal being utilized for the duct pieces. The rates shall be inclusive of the basic sheet metal, flanges, gaskets, bolts & nuts, duct support and hangers, dampers, inspection doors, splitter dampers, straightening, vanes, flexible connections, vibration isolation members provided in duct suspenders and any other item required to make the ducting complete. The thermal insulation and Acoustic lining shall be measured and paid for separately.

The external area of the ducting shall be calculated by measuring the overall width and depth of the duct pipe and the central line length between flanges face to face of the duct piece. This method will be adopted for ducts having uniform cross section. The corner joints shall be included whilst measuring width and depth.

In case of taper pieces, the width and depth shall be equal to the average of bigger and smaller side width and depth respectively. The duct length and area shall be then be calculated as that for straight duct pipes.

For bends and elbows the duct length shall be measured at the curved central line of the bends and elbows. The area shall then be calculated as that for straight duct pieces.

Measurement of ducts shall be carried out before applying insulation. The recorded measurements duly certified by the Engineer in-charge and Owner's Representative shall be attached to every running bill.

- **DUCT INSULATION (Thermal & ACC. Lining of duct)**

The duct areas to be insulated should be measured and recorded as bare duct surface. Then, the thickness of insulation shall be added twice to the depth and width and the insulation area shall be calculated and paid for.

The rate per sq.mt of insulation shall be inclusive of basic insulation material, all finishes as specified.

- **UN-INSULATED PIPING**

✓ The payment for piping system shall be based on the linear measurement of the finished and installed piping works.

✓ The rate per running meter for each diameter of pipes quoted shall include besides the piping material also the fittings, flanges, gaskets, bolt & nuts, pipe supports and hangers, vibration isolation devices for suspenders, flexible connection, Labour charges for pipe fitting, fabrication & erection and any other item of work required to have the system complete.

✓ The rates quoted shall also be inclusive of necessary paint finishing for the entire pipe system.

✓ Underground piping system shall include in the rates quoted the necessary coating as specified under section "Water Piping".

✓ The linear measurement shall be recorded by measuring the central lines distance of the piping system. The same procedure shall be adopted for bends, elbows, reducers etc., however, all types of valves, strainers etc. shall not be included in the measurement.

✓ For valves, strainers etc., payment shall be effected on per unit basis. The no. of installed valves shall be counted and paid for.

✓ All measurements shall be jointly carried out and recorded and countersigned by the Engineer in-charge / Owner's Representative. The measurement sheets should accompany the running bills.

- **INSULATED PIPING**

Payment shall be effected on the same basis as that for iron insulated piping as detailed above. The unit rate for insulation for each dia. Of piping shall be inclusive of basic insulation, and finishes as specified under section "Thermal Insulation". The linear measurement shall be measured and recorded before application of insulation.

Refrigerant Piping

Scope of Works

The scope of this section comprises supply, installation, testing & commissioning of refrigerant piping as detailed below in specifications.

Refrigerant Piping

All refrigerant piping for the air conditioning system shall be constructed from soft seamless up to 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant

circuits.

All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 20Kg per sq.cm and 10 Kg per sq.cm (low side). Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuumif 700mm hg and held for 24 hours.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than 20gauge for pipes up to 19.1mm and 18 gauges for bigger sizes

The suction line pipe size and the liquid line pipe size shall be selected according to the manufacturers specified outside diameter. All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

The OD & wall thickness size of copper refrigerant piping shall be as per VRV / VRF manufacturer standard. **The pipe thicknesses given below are minimum & thickness written in BOQ will supersede this.**

	Outside Diameter (mm)	**Wall Thickness (MM)**
a)	50.8	1.64
b)	44.5	1.64
c)	41.3	1.43
d)	34.9	1.21
e)	28.6	1.0
f)	25.3	0.8
g)	22.2	0.8
h)	19.1	0.8

i)	15.9	0.8
j)	12.7	0.8
k)	9.5	0.8
l)	6.4	0.8

Insulated Flexible ductwork

Insulated Flexible ductwork shall be as described in the SMACNA Low Pressure Duct Standards (5th Edition).

a. Where flexible connections are indicated or required between rigid ductwork and particular components or items of equipment, the internal diameter of the flexible duct shall be equal to the external diameter of the rigid ductwork and of the spigot served. The use of flexible duct between rigid sections of sheet metal ductwork to change direction or planes will not be permitted except where indicated or expressly authorized by the Owner.

b. The flexible duct shall have a liner and a cover of tough tear-resistant fabric equal in durability and flexibility to glass fibre and shall be impregnated and coated with plastics. It shall be reinforced with a bonded galvanized spring steel wire helix between the liner and the cover and an outer helix of glass fibre cord or equal shall be bonded to the cover to ensure regular convolutions.

c. Alternatively the flexible duct shall consist of flexible corrugated metal tubing of stainless steel, aluminium, tinplated steel or aluminium coated steel. The metal may be lined on the inside or the outside or both with plastics material.

d. The joints of rigid spigots shall be sealed with a brush coat of pipe jointing paste or mastic compound. Ducts up to 150mm diameter shall be secured with a worm drive type hose slip. Ducts over 150mm diameter shall be secured with a band clip.

e. The frictional resistance to air flow per unit length of the flexible duct shall not exceed 50% more than the frictional resistance per unit length of galvanized steel ducts of equivalent diameter. The radius ratio R/D for bends shall not be less than 2, where R is the centre line radius and D is the diameter of the flexible duct.

f. Flexible ductwork shall not pass through fire/smoke resistant building construction nor be used at extract points where deposits of flammable substances are likely to occur in high fire risk areas.

g. The leakage from any section of flexible duct shall not exceed 1% of the

design air flow rate at the static operating pressure.

h. Flexible ducts shall be suitable for an operating temperature range of -18^{O}C to 120^{O}C and shall comply with BS 476 Part 1, Section 2, Clause 7 (Class 1: Surface of very low flame spread).

6.11 NOISE & VIBRATION CONTROL

Scope of Work

This section deals with design, supply, installation, testing and commissioning of noise and vibration control equipment and accessories.

Standards

The testing of all noise control equipment and the methods used in measuring the noise rating of air conditioning plant and equipment shall be in accordance with the relevant sections of the following British Standards, unless otherwise stated:

BS 4718: 1971	Methods of Test of Silencers for Air Distribution Systems
BS 2750:	Laboratory and Field Measurement of Airborne Sound
Parts 1-9:1980	Insulation of Various Building Elements
	Recommendations for Field Laboratory Measurement of Airborne and Impact Sound Transmission in Buildings
BS 3638: 1987	Methods of Measurement of Sound Adsorption in a Reverberation Room
BS 4773:	Acoustic Testing.
Part 2: 1976	
BS 4856:	Acoustic performance without additional ducting of forced
Part 2: 1976	Fan convection equipment.
Part 5: 1976	Acoustic performance with additional ducting of forced fan convection equipment
BS 4857:	Acoustic Testing and Rating of High Pressure Terminal
Par 2:1978 (1983)	Reheat Units.
BS 4954:	Acoustic Testing and Rating of Induction Units.
Par 2:1978 (1987)	

BS 5643: 1984 Glossary of Refrigeration, Heating, Ventilating and Air Conditioning Terms

General

The air conditioning contractor must take all necessary precautions to have minimum noise generation and its transmission generated by moving plant and equipment to achieve acceptable limits for occupied areas. In addition to the noise level criteria particular attention must be given to the following details at time of ordering plant and equipment and their installation :-

All moving plant / equipment shall be statically and dynamically balanced at manufacturers works and certificates issued.

The isolation of moving plant, machinery and apparatus including lines equipment from the building structure.

Where duct work and pipe work services pass through walls, floors and ceilings, or wherever supported shall be surrounded with a resilient acoustic absorbing material to prevent contact with the structure and minimize the outbreak of noise from plant rooms.

The reduction of noise breakout from plant rooms and the selection of externally mounted equipment and plant to meet ambient noise level requirements of the Specifications.

Electrical conduits and connections to all moving plant and equipment shall be carried out in flexible conduit and cables to prevent the transmission of vibration to the structure and nullify the provisions of anti-vibration mountings.

All duct connections to fans shall incorporate flexible connections, except in cases where these are fitted integral within air handling units.

All resilient acoustic absorbing materials shall be non-flammable, vermin and rot proof and shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.

Where practicable, attenuators shall be built into walls and floors to prevent the flanking of noise the duct work systems and their penetrations sealed in the manner previously described. Where this is not feasible, the exposed surface of the duct work between the attenuators and the wall subjected to noise infiltration shall be acoustically clad as specified.

Ambient noise from cooling tower also shall be assessed to determine the suitable attenuators that can reduce the noise so as not affecting the adjoiningpublic area.

Sound Attenuators

Attenuators shall be provided in ducts in accordance with acceptable noise level criteria & if

specified in BOQ. Attenuators shall be constructed from high quality pre-galvanized steel sheet casings with lock formed joints along the casing length. Angle iron cross jointing flanges shall be fitted to silencer casings, drilled as required and finished with red oxide primer paint. Acoustic splitters shall be formed by chancel section pre-galvanized sheet steel framework retaining acoustic fill of a density to attain the required performance. Splitters shall have round Nose ends to give smooth entry and exit conditions to minimize air pressure drops. The acoustic fill shall be protected from the air flow by 22 swg minimum perforated galvanized sheet steel. All attenuators shall be selected against a maximum allowable air pressure drop of 100 Pa.

It will be the responsibility of the AC Contractor at the time of placing orders for fan equipment to obtain from the manufacturers, certified sound power levels to enable the selected duct silencers to be checked against the original design information, prior to orders being placed.

Anti-vibration Mountings.

All items of rotating and reciprocating plant and equipment shall be isolated from the structure by the use of anti-vibration materials, mountings or spring loaded supports fixed to either concrete bases, inertia blocks or supportsteels.

Centrifugal fans and motors within air handling units shall be isolated from the frame of the air handling unit by suitable anti-vibration mountings. Fan discharge air connections shall be fitted with approved flexible connections.

Axial flow fans shall be mounted on steel legs as diaphragm plates supported on neoprene in shear anti-vibration mountings, or suspended using spring loaded hangers to suite the application.

Centrifugal pumps shall be mounted on inertia bases consisting of reinforced concrete sub-base, anti-vibration mountings and concrete filled steel upper plinth. The AC Contractor shall be responsible for providing the steel upper plinth and mountings.

Pipe work connections to circulating pumps, cooler coils and other heat exchanger equipment shall be made with flexible connections as per piping Specifications.

The construction of the anti-vibration mountings shall generally comply with the following: -

Enclosed Spring Mounting (Caged or Restrained Springs)

Each mounting shall consist of cast or fabricated telescopic top and bottom housing enclosing one or more helical steel springs as the principle isolation elements, and shall incorporate a built- in leveling device.

The springs shall have an outside diameter of not less than 75% of the operating height, and

be selected to have at least 50% overload capacity before becoming coil bound.

The bottom plate of each mounting shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

Mountings incorporating snobbery of restraining devices shall be designed so that the snubbing damping or restraining mechanism, is capable of being adjusted to have no significant effect during the normal running of the isolated machine.

Open Spring Mountings

Each mounting shall consist of one or more helical steel springs as the principal isolation elements, and shall incorporate a built-in leveling device. The spring shall be fixed or otherwise securely located to cast or fabricated top and bottom plates, and shall have an outside diameter of not less than 75% of the operating height, and shall be selected to have at least 50% overload capacity before becoming coil-bound.

The bottom plate shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

Neoprene-in-Shear Mountings

Each mounting shall consist of a steel top plate and base plate completely embedded in oil resistant neoprene. Each mounting shall be capable of being fitted with a leveling device, and bolt holes in the base plate and tapped holes in the top plate so that they may be bolted to the floor and equipment where required.

Inertia Bases for Pumps.

The inertia base shall be an all welded mild steel channel frame the minimum depth of which shall be 1/12 of the longest span between isolator but not less than 150 mm. filled with concrete the density of which shall be 2300 kg/m3.

The inertia base shall be sufficiently large to provide support for all parts of the equipment, including any component, which overhands the equipment base, such as suction, and discharge elbows on centrifugal pumps.

The frame shall include pre-located equipment anchor bolts fixed into position and housed in a steel sleeve allowing minor bolt location adjustment.

Isolator support brackets shall be welded into the corners of the base and suitably re-enforced for the load of the equipment and base.

Additional reinforcing roads shall be provided at 200 mm. centers to ensure the concrete and frame is adequately stiffened against distortion.

6.12 PAINTING WORK

This section deals with painting of various equipment / material supplied under this contract. It gives basic guidance for painting as specified below:-

Application: The original colour of all equipments like water chilling machines, air-handling units etc. which if get damaged during transportation or during installation shall be painted in original shade with the two coat of paint to give a final finish.

All chilled water pipes shall be painted as per standard code of practice and arrows shall be marked to indicate direction of flow of water.

Colour Scheme for the Equipment / Materials

Description	Standard Colour & Reference	Lettering Coloring
Exposed Duct Work (other than plant room)	To requirement	Contractor instruction
Air Conditioning Duct Work (Plant Rooms)	BSS 111 Pale Blue	Black
Ventilation Duct Duct Work (Plant Rooms)	BSS 111 Pale Blue	Black
Conditioner Casings Air Handling Units, Filter Plenums	BSS 111 Pale Blue	Black
Electrical (Conduit Ducts and Motors)	BSS 557 LightOrange	Black
Chilled Water Pipe	Jade Green	Black
Drains	Black	White
Vents	White	Black
Fans	BSS 111 Pale Blue	Black
Valves and Pipe Line Fittings	White with black handles	Black
Beltquards	Black and yellow diagonal stripes (45 25 mm wide)	
Switchboards- exterior – interior	BS 366 Light Beige	White
Machine Bases, Inertia Bases and Plinths	Charcoal	Grey
Chilling M/C	As Per Manufacturer’s Standard	
Pump-sets	Battle ship grey	

Description	Standard Colour & Reference	Lettering Coloring
Condenser water pipes	Light green	Black
Electrical panels/sub-panel/ remote control console	Light grey powder coated RAL 7032 as per DIN	
Supports for ducts		Silver

6.13 MODE OF MEASUREMENT

The following measurement code shall apply to the Contract:

Sheet Metal Work

Ducting

- The final finished sheet area in sq. mt shall be measured only.
- Vanes, splitters, flanges, access doors etc. shall not be separately measured. These shall be treated as part of duct work.
- Bends, Elbows, Transformation, pieces etc. shall be measured along the centre line and measured as per duct work.

Canvas connections, Duct Supports, Stiffening members, frames etc. shall not be measured separately and shall form part of duct work / equipment.

Grills / Diffusers / Fire Dampers

All Grills / Diffusers / Fire Damper areas will be measured in terms of effective area (Neck Area). Any Extruded aluminum grill / diffusers having an area less than 0.1 sq.mt shall be accounted as 0.1 sq.mt.

Box Dampers

Duct dampers shall be measured in Sq. Mt. in terms of effective area.

Fresh air dampers shall be measured as effective areas only. No separate measurements for bird screen inlet / outlet louvers shall be done.

Piping Work

a) The length of piping accessories & fittings shall be measured along its centre line in meters and no measurements for bends, elbows, tees etc. shall be made. All such fittings / accessories shall be treated as part of the piping work.

b) Flanges shall not be measured, as they form part of piping work.

c) For thermometer wells & pressure gauge sockets no measurement shall be done separately.

d) All kinds of supports, hangers etc shall be part of piping work & no extra measurements shall be done.

e) No additional price for installation of purge & de-scaling valves as required at site shall be paid.

Insulation

Insulation of Duct

This shall be measured on the basis of bare duct surface area i.e. the area of duct insulation & area of duct shall be same.

Insulation of Chilled Water / Drain Water Pipes.

i) Insulation of pipes shall be measured in terms of linear length of pipefor each size.

ii) For insulation of bends, elbows, tees etc. it shall be measured alongwith the center line of insulation and shall be measured in meters.

iii) Insulation of valves shall be separately accounted as per bill ofquantities.

Insulation of Chiller / Expansion Tank / Suction Line

The insulation of the above equipments shall be deemed to form part of equipment and no separate measurements for insulation of such items willbe accounted for.

Acoustic Lining of Duct & Plenum

This shall be measured on the basis of bare duct surface area i.e. the area of duct lining & area of duct shall be same.

Electrical Cabling Work

a) All power cables / controls cables shall be measured on linear basis in meters.

b) No extra price shall be paid on account of end termination of cables which includes thimble, gland etc.

Structural Supports

No extra price shall be paid on account of structural supports required for piping, ducting & cabling work.

Note: - The items not specified above or not specified in BOQ & Specification but technically required shall be part of that particular equipment / material.

Flexible Pipe Connector

Flexible pipe connector wherever required are part of the equipment & are specified in BOQ

with the equipment. No extra price shall be paid on account of this.

6.14 LIST OF ABBREVIATIONS

Followings List of Abbreviations shall have been used in preparing the Tender Specifications, Bill of Quantities & Drawings.

AABC : AMERICAN AIR BALANCING COUNCILACH: AIR CHANGE PER HOUR

AC : AIR CONDITIONING

ACMV : AIR CONDUCTING AND MECHANICAL VENTILATIONAHU: AIR HANDLING UNIT

ANSI : AMERICAN NATIONAL STANDARD INSTITUTEARI : AMERICAN REFRIGERATION INSTITUTE

ASHRAE: AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIRCONDITIONING ENGINEER

ASME : AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASTA : ASSOCIATION OF SHORT - CIRCUIT TESTING AUTHORITIES

ASTM : AMERICAN SOCIETY OF TESTING AND MATERIALS

ATG : AIR TRANSFER GRILLE

AWS : AMERICAN WELDING SOCIETY

BAS : BUILDING AUTOMATION SYSTEM

BIS : BUREAU OF INDIAN STANDARD

BMS : BUILDING MANAGEMENT SYSTEM

BTU : BRITISH THERMAL UNIT

CDW : CONDENSER WATER

CFM : CUBIC FEET PER MINUTE

CHW : CHILLED WATER

CMS : CENTRAL MONITORING SYSTEM

CRCA : COLD ROLLED COLD ANNEALED

CSA : CANADIAN STANDARD ASSOCIATION

CT : COOLING TOWER

CTI : COOLING TOWER INSTITUTE

DB : DISTRIBUTION BOARD

DDC : DIRECT DIGITAL CONTROLLER

DOL : DIRECT ON LINE

DFA : DELHI FIRE AUTHORITY

DIA : DIAMETER

DIDW : DOUBLE INLET DOUBLE WIDTH

DX : DIRECT EXPANSION
EA : EXHAUST AIR
EEPROM: ELECTRICAL ERASABLE PROGRAM
ELCB : EARTH LEKAGE CIRCUIT BREAKER
ETL : ELETRICAL TESTING LABORATORIES
EPA : ENVIRONMENTAL PROTECTION ACT
FCU : FAN COIL UNIT
F/A : FLOOR ABOVE
F/B : FLOOR BLOW
FCC : FIRE COMMAND CENTRE
FD : FIRE DAMPER
FFL : FINISHED FLOOR LEVEL
FPM : FEET PER MINUTE
FPS : FOOT PER SECOND
FRP : FIBERGLASS REINFORCED PLASTIC
GI : GALVANISED IRON
GPM : GALLON PER MINUTE
GSS : GALVANIZED STEEL SHEET
H/L : HIGH LEVEL
HDG : HOT DIP GALVANIZED
HDPE : HIGH DENSITY POLY ETHANE
HFC : HYDRO FLURO CARBON
HP : HORSE POWER
HVAC : HEATING, VENTILATION & AIR CONDITION
INGIAQ : INDOOR AIR QUALITY
IEC : INTERNATIONAL ELECTROCHEMICAL COMMISSION
IKW : INDICATED KILO WATT
IPD : INITIAL PRESSURE DROP
ISO : INTERNATIONAL STANDARD ORGANIZATION
KW : KILO WATT
L : LITRE
LCD : LIQUID CRYSTAL DISPLAY
L/L : LOW LEVEL
L/S : LITRE PER SECOND
LSZH : LOW SMOKE ZERO HALOGEN

LT	:	LOW TENSION
MAX.	:	MAXIMUM
MCB	:	MINIATURE CIRCUIT BREAKER
MCC	:	MOTOR CONTROL CENTRE
MFD	:	MOTORIZED FIRE DAMPER
MIN	:	MINIMUM
MM	:	MILLIMETER
NBC	:	NATIONAL BUILDING CODE
NC	:	NOISE CRITERIA
NEC	:	NATIONAL ELECTRIC CODE
NFPA	:	NATIONAL FIRE PROTECTION ASSOCIATION
NPLV	:	NET PART LOAD VALUE
NIST	:	NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY
NEMA	:	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NPSH	:	NET POSITIVE SUCTION HEAD
NTS	:	NOT TO SCALE
OA	:	OUTDOOR AIR
PHE	:	PUBLIC HEALTH ENGINEERING
PLC	:	PROGRAMMABLE LOGIC CONTROLLER
P.C.	:	PERSONAL COMPUTER
PSIG	:	POUNDS PER SQUARE INCH GAUGE
PUF	:	POLYURETHANE FOAM
RA	:	RETURN AIR
RAD	:	RETURN AIR DUCT
RCC	:	REINFORCED CEMENT CONCRETE
RH	:	RELATIVE HUMIDITY
RPM	:	REVOLUTIONS PER MINUTE
SA	:	SUPPLY AIR
SAD	:	SUPPLY AIR DUCT
SMACNA	:	SHEET METAL & AIR CONDITIONING CONTRACTORSNATIONAL ASSOCCIATION.
STD	:	STANDARD
T/A	:	TO ABOVE
TAB	:	TESTING, ADJUSTING AND BALANCING
T/B	:	TO BELOW

TCC	:	TERMINAL CONTROL CENTRE
TFA	:	TREATED FRESH AIR
TOA	:	TREATED OUTDOOR AIR
TP	:	THREE PHASE
TR	:	TONS OF REFRIGERATION
TVOC	:	TOTAL VOLATILE ORGANIC COMPOUNDS
VAV	:	VARIABLE AIR VOLUME
VFD	:	VARIABLE FREQUENCY DRIVES
VIP	:	VIBRATION ISOLATING PAD
VSPS	:	VARIABLE SPEED PUMPING SYSTEM
XLPE	:	CROSS -LINKED POLYETHYLENE
SISW	:	SINGLE INLET SINGLE WIDTH
UL	:	UNDERWRITERS LABORATORIES INC.
WG	:	WATER GAUGE

SECTION – 3 F

7. ALLIED SERVICES

7.1.MEDICAL GAS PIPELINE SYSTEM (MGPS)

7.1.1. SCOPE OF WORK

The Medical Gas Pipe Line System (MGPS) includes the following items to be included on turn key basis, as per individual site requirements:

- Provision to connect to LMO tank system (of required capacity) which will be the primary source. Provision includes supply & commissioning of Control Panel & Automatic Switch overs which is part of the secondary source.
- Secondary oxygen manifold and emergency oxygen manifold with automatic control panels with switch over systems.
- Nitrous oxide manifold and emergency NO manifold with automatic control panel.
- CO2 Manifold and Emergency CO2 Manifold with automatic control panel.
- Medical Air 2 Supply System (4 Bar & 7 Bar) complete.
- Medical Vacuum (suction) Supply System Complete.
- AGSS systems complete Distribution Piping Complete with accessories.
- Area Valve Service Unit System.
- Control cabling from / to control panel and associated sensors Alarm systems (master & area).
- Gas Outlets with Probes.
- Surgeon Control Panel
- Bed Head Panels.
- Wall outlet boxes
- Anaesthesia Pendant
- Surgeon Pendant
- BPC Flow Meter
- Terminal Vacuum unit
- Theatre Vacuum Units
- Other associated works.
- Comprehensive Maintenance of MGPS Installations.
-

7.1.2. THE DESIGN OF THIS MGPS INSTALLATION MUST;

a) Ensure Quantity of Supply
b) Ensure Identity of Supply
c) Ensure Continuity of Supply
d) Ensure Quality of Supply

7.1.3. OXYGEN SCOPE AND TECHNICAL SPECIFICATION

Oxygen Supply Systems
Provision to Liquid Medical Oxygen Tank

A ball valve (closed) is fixed on the feeder line of oxygen delivery system which can be opened when the LMO tanks are included in the MGPS, for delivery of oxygen to the main distribution line, as primary delivery system. The valve fixed on the oxygen copper pipeline is before the automatic control panel of oxygen delivery system.

Oxygen Manifold Supply System (without Cylinders)

The size of Manifolds shall be as mentioned in BOQ of respective site/ hospital and it shall be compatible with Class-D type bulk cylinders. Manifold shall consist of two high pressure header bar assemblies to facilitate connection of primary and secondary cylinder supplies. Each header bar shall be provided with respective numbers of cylinder pigtail connections to suit cylinder valves as per IS.3224/ BS/ ASME incorporating a check valve at the header connection.

Each header bar assembly shall be provided with a high pressure shut off valve. Oxygen Manifold shall consist of respective numbers of class D-type bulk oxygen cylinders. The manifold shall be hydraulically tested to atleast3000 psig. The manifold shall be so designed that it shall suit easy cylinder changing and positioning. The system shall have non – return valves for easy changing of cylinders without closing the bank along with individual cylinder valve and pressure relief valve. The cylinder shall be placed with the help of cylinder brackets and fixing chains which shall be galvanized. Shall be BIS/European CE certified.

Oxygen Flow meter with Humidifier Bottle for other than ICU area

Back Pressure Compensated flow meter for accurate gas flow measurement with following features:

Control within a range of 0-15 LPM.

It shall strict and durability standard.

The flow meter body shall be made of brass chrome plated materials.

The flow tube and shroud components shall be made of clear, impact resistant poly carbonate.

Flow tube shall have large and expanded 0-15 LPM range for improved readability at low flows.

Inlet filter of stainless-steel wire mesh to prevent entry of foreign particles.

The humidifier bottle is made of unbreakable & reusable polycarbonate/poly sulfone material auto clavable at 121 degrees centigrade.

Oxygen Flow meter & Humidifier Bottle for ICU

Back Pressure Compensated flow meter for accurate gas flow measurement with following features:

Control within a range of 0-15 LPM.

It shall strict and durability standard.

The flow meter body shall be made of brass chrome plated materials.

The flow tube and shroud components shall be made of clear, impact resistant

polycarbonate.

Flow tube shall have large and expanded 0-15 LPM range for improved readability at low flows.

Inlet filter of stainless-steel wire mesh to prevent entry of foreign particles.

The humidifier bottle is made of unbreakable & reusable polycarbonate/polysulfone material autoclavable at 121 degreescentigrade.

The humidifier should completely made of polycarbonate and it can be sterilized in autoclave at 121 °C for 15 min.

For the inlet connection it should have some snap inserts, identified with color-coded, with different threads to be chosen by the end user.

An ergonomic and big size rotating nut allows to easily connect and disconnect the humidifier to the oxygen supply device, the 360° rolling positioning hose connector ø 6 - 9 mm allows an easy use of the humidifier.

The bottle should have hollow shape, besides being a design unique element, offers the operator an easy and safe handling. The humidifier should have an integrated relief valve.

Shall be European CE certified with 4 digit notified body no./UL Listed/ETL listed.

Fully Automatic Oxygen Control Panel (for High Pressure Oxygen Manifold Cylinder)

Automatic control panel shall be constructed in accordance with the requirement of international standards. The fully automatic oxygen control panel shall comply with HTM 02-01/ ISO- 7396-1/ NFPA 99C standards and Medical Device Directive 93/42/EEC. It shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed.

The specifications shall be referred in the following order of preference:1) HTM 02-01,2) ISO 7396-1 3) NFPA 99. The preference shall be to follow Single Standard as specified above for relevant equipment

Product should be mechanical tested & certified from Third party for:

1. Regulators Ignition Test
2. BAM Test (Bacterial Analytical Test)
3. Adiabatic certification (thermodynamic process)
4. Pressure Test
5. Flow Test
6. Pneumatic Test in case of power failure.
7. Indicators Test
8. Change Over manifold test
9. Gauge Calibration test

The manifold assembly shall provide two stages of pressure regulation Each manifold header bar assembly shall be provided with a high pressure shut off valve along with individual cylinder valve. The Control Panel must have 2 stage network pressure reducing system equipped with safety valves, first stage reducer to reduce the high pressure from the source to a medium pressure and the second stage reducer to reduce the medium pressure to the line pressure to ensure safety.. A single stage primary regulator, one for each cylinder bank shall be used to initially reduce cylinder pressure and two single stage pressure regulators shall be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one shall be ready for service in a standby mode. The Manifold control panel shall be with digital display, fully automatic type and switches from "Bank in Use" to "Reserve bank " without fluctuation in delivery supply line pressure. It must have pressure gauges at all important control points so that the state of the system can still be assessed even in the event of a power failure. Changeover shall be performed by electrically/pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure (in case of electronically operated) the valves shall automatically open to provide an uninterrupted gas flow. Major valve must be of brass to avoid wear and to have long lasting service free lifetime. It shall be 100% automatic and shall not require manual adjustment. An emergency supply point via NIST connector coupling must be provided to ensure uninterrupted gas supply in case of any emergency during maintenance/ service.

Indication for changing the cylinders shall be clearly identified on the front of the control panel.

All functional components shall be enclosed in corrosion resistant robust material. The electronic control unit must be enclosed in galvanized metal housing, terminal strip on electronic housing to ensure safety. The power supply (AC-DC Converter unit) must be external to the Control panel to ensure safety. All components inside the Control Panel like Pressure Regulators, piping and control switching equipment shall be cleaned for Oxygen Service and installed inside the cabinet made of mild steel with epoxy powder coated with a viewing window to monitor digital display to minimize tampering with the regulators or switch settings. The cabinet must have hydraulically operated doors and should be able to operate/open easily (hydraulically) to save space during service or maintenance.

All functional components shall be enclosed in corrosion resistant robust material. The electronic control unit must be enclosed in galvanized metal housing, terminal strip on electronic housing to ensure safety. The power supply (AC-DC Converter unit) must be external to the Control panel to ensure safety.

All components inside the Control Panel like Pressure Regulators, piping and control switching equipment shall be cleaned for Oxygen Service and installed inside the cabinet made of mild steel with epoxy powder coated with a viewing window to monitor digital display to minimize tampering with the regulators or switch settings. The cabinet must have hydraulically operated doors and should be able to operate/open easily (hydraulically) to save space during service or maintenance.

The Control Panel shall include two pressure relief valves, one high pressureapproximate 200/350psi and one low pressure approximate 75 psi.

The heavy duty control panel shall be provided with a flow capacity of 1500 or more LPM at 50 to 60 psi or as per design.

The Automatic Control Panel shall be installed in such a way to meet the peak flow requirement of the Hospital/Institute (If the requirement is more than flow capacity requirement automatic control panel the bidders has to supply 02 numbers of Automatic Control Panel and design the system in such a way to meet the flow requirement of respective institute)

Control Panel should have automatic acknowledgement/ reset facility. The manifold panel must be connected with Master Alarm to show the parameters on Master Alarm Panel.

Automatic switch over of source gas of Medical oxygen

Technical Specs: -

- Auto Change over Unit comes with IoT Capability and Compact Design with LCD Touch Screen Control System. Capable of supply from 3 different sources:
- Primary Source: - MBC Dura Cylinder 1.
- Secondary Source: - MBC Dura Cylinder 2.
- Reserve Source: - D Type Bulk Cylinder Manifold.
- Supply Sources can be customized as per the Hospital requirement/Need
- Auto Change Over / Augment System works with either Pressure based on the availability of supply sources
- If the selected Primary Source failed to supply at required pressure, the secondary available source will augment to compensate the required pressure. when the primary source reaches normal condition, the augmented source supply turned off automatically.
- Abnormalities of the Gas Pressure warnings to be communicated with respective persons via Telegram messages and Email (Customized feature) until the pressure level restored to the normal condition.

Features: -

- Compact Design with 10.1 HMI Inch LCD Touch Screen.
- Device/Sensor/Valve failure Alert / Error message will display until it gets rectified.
- Capable of storing device data logging into SD Card for Reporting Purpose download data logging from SD Card into Excel File report can be generated to check flow and overall consumption for the given period.
- Control panel access are password protected.
- BMS System Incorporated

7.1.4. NITROUS OXIDE SYSTEM

Fully Automatic Nitrous Oxide Control Panel

The fully automatic N2O control panel shall comply with HTM 02-01/ ISO 7396-1/ 2NFPA 99 C STANDARDS and Medical Device Directive 93/42/EEC. It shall be European CE Certified with 4 digit notified body number or American ETL/American UL listed.

The specifications shall be referred in the following order of preference:

1) HTM 02-01,ISO 7396-1 3) NFPA 99. The preference shall be follow Single Standard as specified above for relevant equipment.

Product should be mechanical tested & certified from Third party for:

1. Regulators Ignition Test
2. BAM Test
3. Adiabatic certification
4. Pressure Test
5. Flow Test
6. Pneumatic Test in case of power failure.
7. Indicators Test
8. Change Over manifold test
9. Gauge Calibration test

The manifold assembly shall provide two stages of pressure regulation. Each manifold header bar assembly shall be provided with a high pressure shut off valve along with individual cylinder valve. The Control Panel must have 2 stage network pressurereducing system equipped with safety valves, first stage reducer to reduce the high pressure from the source to a medium pressure and the second stage reducer to reduce the medium pressure to the line pressure to ensure safety. A single stage primary regulator, one for each cylinder bank shall be used to initially reduce cylinder pressure and two single stage pressure regulators shall be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one shall be ready for service in a Standby mode. The Manifold control panel shall be digital, fully automatic type and switches from “Bank in Use” to “Reserve bank “without fluctuation in delivery supply line Pressure. It must have pressure gauges at all important control points so that the state of the system can still be assessed even in the event of a power failure.

Changeover shall be performed by electrically/ pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure (in case of electrically operated) the valves shall automatically open to provide an uninterrupted gas flow. Major valve must be of brass to avoid wear and to have long lasting service free lifetime.

The manifold shall not require any manual resetting or adjustments after the replacements of the depleted cylinders. An emergency supply point via NIST connector coupling must be provided to ensure uninterrupted gas supply in case of any emergency during maintenance/ service.

All functional components shall be enclosed in corrosion resistant robust material. The electronic control unit must be enclosed in galvanized metal housing, terminal strip on electronic housing to ensure safety. The power supply (AC-DC Converter unit) must be external to the Control panel to ensure safety.

The Control Panel shall include two pressure relief valves, one high pressure approximate 200 psi and one low pressure approximate 75 psi. The control panel shall also have heaters to prevent ice formation on the regulators at high flow rates.

The Control Panel shall be made to provide Heavy Duty and have a flow capacity of 1500 LPM or more at 50to 60 psi. The Automatic Control Panel shall be installed in such a way to meet the peak flow requirement of the Hospital/Institute (If the requirement is more than flow capacity requirement automatic control panel the bidder has to supply 02 numbers of Automatic Control Panel and design the system in such a way to meet the flow requirement of respective institute).

All components inside the Control Panel like Pressure Regulators, piping and control switching equipment shall be cleaned for Nitrous Oxide Service and installed inside thecabinet made of mild steel with epoxy powder coated with a viewing window to monitor digital display to minimize tampering with the regulators or switch settings. The cabinet must be able to operate/open easily (hydraulically) to save space during service or maintenance.

Control Panel should have automatic acknowledgement/ reset facility.

The manifold panel must be connected with Master Alarm to show the parameters on.

Master Alarm Panel.

Nitrous Oxide Manifold (Without Cylinders) The size of Manifolds shall be as mentioned in BOQ of respective Institute and it shall be compatible with Class-Dtype bulk cylinders.

Manifold shall consist of two high-pressure header bar assemblies to facilitate connection of primary and secondary cylinder supplies. Each header bar shall be provided with respective number of cylinder pigtail connections to suit cylinder valves as per IS.3224/ BS/ ASME incorporating a check valve at the header connection. Each header bar assembly shall be provided with a high pressure shut off valve along with individual cylinder valve. The manifold shall be hydraulically tested to at least 3000 psi.

The manifold shall be so designed that it shall suit easy cylinder changing and positioning. The cylinder shall be locked with the help of cylinder brackets and fixing chains which shall be galvanized. Shall be BIS/European CE certified with 4 digit notified body no./ UL Listed/ETL listed.

Emergency N2O Manifold (Without Cylinders)

The size of Manifolds shall be as mentioned in BOQ of respective Institute and it shall be compatible with Class-D type bulk cylinders.

Manifold shall consist of high-pressure header bar assemblies to facilitate connection of cylinder supplies. Header bar shall be provided with respective numbers of cylinder pigtail

connections to suit cylinder valves as per IS 3224/ BS/ ASME incorporating acheck valve at the header connection. Header bar assembly shall be provided with a high pressure shut off valve. Nitrous oxide manifold shall consist of respective numbers of cylinders.

The manifold shall be hydraulically tested to at least 3000psig. The manifold shall be so designed that it shall suit easy cylinder changing and positioning. The system shall have non – return valves for easy changing of cylinders without closing the bank. The cylinder shall be placed with the help of cylinder brackets and fixing chains which shall be galvanized. Shall be BIS/European CE certified with 4 digit notified body no./ UL Listed/ETL listed.

Carbon Di Oxide System

The system shall consist of medical CO2 Manifold Primary & Standby (as per the 2 configurations mentioned in NIT) with Class-D type Cylinders and control panel. Control panel of CO2 shall be European CE Certified or American ETL/ American UL 2listed.

The Modular Manifold supply system shall provide carbon dioxide piped distribution system.

The Modular Manifold system shall be in such a way that it increases flexibility and allows easy enlargement of the manifold capacity in case of future expansion. Shall be compliant with HTM 02-01/ISO 7396-1/ NFPA 99 C standard and Medical Device Directive 93/42/EEC. The specifications shall be referred in the following order of preference :1) HTM 02-01, ISO 7396-1 , 3) NFPA 99. The preference shall be follow Single Standard as specified above for relevant equipment. The system shall have non – return valves for easy changing of cylinders without closing the bank along with individual cylinder valve and pressure relief valve. The cylinder shall be placed with the help of cylinder brackets and fixing chains which shall be galvanized.

Fully Automatic Control panel for CO2 System

The Manifold Control System shall supply any type of medical gas from both left and right hand manifold banks. Operation and performance criteria shall fully satisfy the requirements of HTM 02-01/ ISO 7396-1/ NFPA 99 C standard. The fully automatic CO2 control panel shall comply with the standard and Medical Device Directive 93/42/EEC. It shall be European CE Certified or American ETL/ American UL listed. The Manifold Control System shall supply on uninterrupted flow of 500 L/min. to a 400 kPa (4 bar) distribution system. Either the left or right hand manifold bank may be designated "Duty" and shall automatically changeover to supply the distribution system from the "Standby" bank when pressure in the "Duty" bank falls to a predetermined level.

The Control Panel must have 2 stage network pressure reducing system equipped with safety valves, first stage reducer to reduce the high pressure from the source to a medium pressure and the second stage reducer to reduce the medium pressure to the line pressure to ensure safety. A single stage primary regulator, one for each cylinder bank shall be used to initially reduce cylinder pressure and two single stage pressure regulators shall be provided in the control cabinet for final delivery pressure regulation. One delivery pressure regulator in service and one shall be ready for service in a standby mode. The Manifold control panel shall be with digital display, fully automatic type and switches from “Bank in Use” to “Reserve bank “ without fluctuation in delivery supply line pressure. It must have pressure

gauges at all important control points so that the state of the system can still be assessed even in the event of a power failure. Changeover shall be performed by electrically/pneumatically operated valves contained in the control cabinet. In the event of an electrical power failure (in case of electronically operated) the valves shall automatically open to provide an uninterrupted gas flow. Major valve must be of brass to avoid wear and to have long lasting service free lifetime. It shall be 100% automatic and shall not require manual adjustment. An emergency supply point via NIST connector coupling must be provided to ensure uninterrupted gas supply in case of any emergency during maintenance/ service. All functional components shall be enclosed in corrosion resistant robust material. The electronic control unit must be enclosed in galvanized metal housing, terminal strip on electronic housing to ensure safety. The power supply (AC-DC Converter unit) must be external to the Control panel to ensure safety.

All components inside the Control Panel like Pressure Regulators, piping and control switching equipment shall be cleaned for Carbon Dioxide Service and installed inside the cabinet made of mild steel with epoxy powder coated with a viewing window to monitor digital display to minimize tampering with the regulators or switch settings. The cabinet must have hydraulically operated doors and should be able to operate/open easily (hydraulically) to save space during service or maintenance.

Medical and Surgical Air System

(Package Unit) - Tolerance of +/-5% is acceptable on plant flow capacity.

Air-cooled, Oil Free/Oil-Less compressors for continuous duty application with highest output of compressed air, low power consumption and very low vibration resulting in low noise level.

Note: The system configuration shall be as per provisions in chapter 2 para 2.27

Note: The type of compressor to be decided and specifications to be mentioned in NIT accordingly. The above is for Oil Free/ Oil less compressor screw/ scroll. The medical air plant shall fully comply with the requirements of the HTM 02-01/ ISO 7396-1/ NFPA 99 C. It shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed (In case of NFPA 99c the control panel of plant must be UL/ETL Listed and under taking from manufacturer for this tender reference must be submitted for using the same control panel in the system offered).

Air Compressor Modules

It shall be Oil-Free/Oil-Less Screw Compressors /Scroll Compressors to produce the plant output of {Minimum113cfm to deliver each compressors Plant capacity} as mentioned in BOQ of respective institute as primary and same capacity as standby. The compressor shall have a sound insulating enclosure. Medical quality air shall be delivered at a nominal pressure of 400 kPa (4 bar) and 700kPa (7 bar) gauge for supply of the hospital medical air and surgical air.

The Medical Air Quality parameter to be achieved shall be as per following:

Contaminant	**Threshold**
H2O	67 ppm v/v
Dry Particulates	Free from visible Particulates in a 75 litre sample
Oil (droplet or mist)	**0.1mg/cubic metre**
CO	**5ppm v/v**
CO2	**500 ppm v/v**
SO2	**1ppm v/v**
NO	**2 ppm v/v**
NO2	**2 ppm v/v**

The medical air purification module shall incorporate high efficiency water separators, oil coalescing filters, heatless regenerative desiccant dryers, activated carbon filters with hopcalite catalyst, bacterial filters and pressure regulators. The performance of the filters shall be according to below specifications: Oil coalescing two-in-one high efficiency filter: mass efficiency of 99,991%, tested according to ISO 8573-2 & ISO 12500-1 Activated carbon filter: max remaining total oil content of 0,003 mg/m³, tested according to ISO 8573-5 & ISO12500-2 Bacterial filter: particle count efficiency of 99,98% at MPPS=0.06µm, tested according to ISO 12500-3. Compressor plant shall be designed in such a way that compressors will switch on in a sequential manner as per flow demand. The compressors shall be standalone ones with independent power supply. Each Compressor shall be suitable for both continuous and frequent start/stop operation at a nominal plant pressure of 10 bar or more.

The duty compressors shall be automatically rotated by the plant control system to ensure even wear compressors shall be supplied and installed. Desiccant dryer shall be provided with a dew point sensing switch that shall provide an alarm on the plant control panel and central hospital alarm system when the water concentration in the delivered air rises above the limit. Duplex desiccant dryer and filtration modules shall be provided with three or more individual stages of filtration as follows:

Stage 1: Coalescing filter upstream of the desiccant dryer for removing liquid water particles down to 1micron.

Stage 2: Particulate filter after the desiccant dryer for dust protection and removing particles down to 1micron.

Stage 3: Bacteria filter for removing particles down to 0.01 micron. Purity shall be tested as per the American Pharmacopeia / European Pharmacopeia standard.

The plant control and power management system shall monitor the safe operation of the plant, providing signal into the alarm system as per the requirements of the standard.

Pressure Reducing Station:

For 4 bar and 7 bar shall fully comply and meet with the requirements of the standard. Simplex pressure reducing station shall comprise as in-line pressure regulator, with

downstream pressure gauge. Isolation valves and pressure release valves shall be provided as per the standard. Duplex pressure reducing station to have two branches, connected to the MGPS in parallel in order to allow maintenance on the components of one branch, while the gas flow is maintained in the other branch.

The compressor system shall have

a) Intake filter Delivery pipe
b) Mounting on air tank along with all standard fittings viz. safety valve, pressure gauge, delivery valve, drain valve etc.
c) Bidder shall provide all electric control panels, starters etc required for proper functioning of MGPS.
d) Desiccant Air Dryer – 2nos. (Duplex each)
e) 4-Stage or more Breathing Air Filters – 2 sets
f) Outlet pressures for drills/equipment and ventilators shall be a minimum of 7 bar and 4bar respectively.
g) Duplex pressure reducing station
h) The compressor shall be heavy duty, reliable with long MTBF (Mean Time Between Failure). Each compressor cylinder is to be protected by a temperature switch, which will stop the drive MGPS and provide an alarm signal in the event of abnormal discharge air temperature. Each compressor module shall include an inline filter with particleretention of 10 microns, inlet isolation valve, discharge isolation valve, and pressure relief valve. The capacity shall be capable to take care of total load of all the outlets

Vertical Air Receiver Total air receiver capacity shall be at least 50% (+/- 5%) of the primary plant capacity (capacity as mentioned in the tender) in terms of free air delivered at normal working pressure. Each air receiver shall be protected by a pressure relief valve, a fusible plug and include a pressure gauge with isolating valve and a drain cock.

Air receivers should comply with BS EN 286-1: 1998 for all vessels up to 10,000 bar litres, and should be supplied with test certificates. The minimum water capacity of the receivers should be 50% of the compressor output, stated in terms of free air delivered at normal working pressure. Receivers should also be fitted with an automatic drain. Electrically operated automatic drains have been found to be more reliable. For systems that have a design flow in excess of 500 L/min, two receivers should be provided with valve arrangements to permit isolation of one or the other for inspection purposes.

Air Receivers Tanks should conform to ASME Boiler and Pressure Vessel Code 2017,Section VIII. It will preferably be a Vertical, Cylindrical, Stainless Steel Tank (304/304L), for providing rust protection. It must be durable, corrosion resistant and be able tomaintain air purity. These shall be provided with valve arrangements to permit isolationof one or the other for inspection purposes.

The corrosion resistant coated receiver is to be equipped with tested safety pressure reliefvalve, sight glass pressure gauge, automatic drain, three-valve by-pass and sourceisolation valve.

Air Treatment Module

The air treatment module shall include dual dryers, dual filtration system and a dew point transmitter with local audible and visual signals and dry contacts for MGPS monitoring.

The components shall be mounted on a common base with interconnecting copper/brass piping and upstream and downstream isolation valves. The isolation valves must allow either set of components to be serviced without shutting down the system. Dryers shall be of heatless desiccant design and sized to provide for the peak calculated demand. The desiccant dryers shall be equipped with dew point dependent switching feature to minimize the need for purge air. The dual filtration system shall remove liquid and particulate matter, consisting of0.5micron coalescing filters with differential pressure indicators and automatic drain, airline pressure regulators with gauges, final pressure relief valve, and sampling valve. Each bank shall consist of three stage treatment. Digital dew point monitor is to be supplied with alarm contacts as per requirement of the standard.

System Controls

The "Continuous on Demand" feature will stop the operation of the MGPS during periods of low or no demand. The control include individual self-protected combination MGPS controls with short circuit protection, single phase and thermal overload protection, individual control circuit with transformers primary and secondary protection, pressure sensors, temperature switches with reset buttons, and an electronic controller to automatically change the operating sequence of the compressors. The cabinet shall have status display to include system pressure, dew point pump operation, accumulated time, maintenance interval, fault conditions, and silence button, lighted Hand-Off-Automatic selector switches and safety disconnect operating handles. All required local alarm functions shall be integrated in to the packaged system. The system shall be designed to function even if the programmable controller fails.

Accessories

Accessories including for job site installation such as inlet and discharge flexible connectors, vibration mounting pads, and source isolation valve shall be supplied. All the filters shall be covered under warranty period and CMC Period.

VACUUM SYSTEMS

(Package Unit) – Tolerance of +- 5% is acceptable in plant capacity.

It shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed (In-case of NFPA 99c the control panel of Plant must be UL/ETL Listed and Undertaking from manufacturer must be submitted for using the same control panel in the system offered)and shall comply with HTM 0201/ ISO 7396-1/ NFPA 99 C

Vacuum Pump Module

It shall be Oil Sealed Rotary Vane/ Screw Type to produces the plant output of {minimum Litres Per Minutes (5190LPM) Plant capacity} as mentioned in BOQ/NIT Designed flow capacity shall be minimum of LPM capacity as mentioned in BOQ/NIT of respective institute. The vacuum plant shall comprise air-cooled, oil lubricated rotary vane vacuum pumps suitable for both continuous and frequent start/stop operation at inlet vacuum levels

between 450 mmHg and 660 mmHg. The control system shall normally employ automatic rotation of the lead pump to maximize pump life and ensure even wear. Vacuum pump inlets shall include a wire mesh filter and integral non-return valve to prevent oil suck back and pressure increases in the vacuum system. Each vacuum pump shall be fitted with anti-vibration pads between the pump foot and mounting frame. The plant shall be fitted with duplex bacteria filter system.

Vacuum Receiver

The vacuum receiver shall be made of rust free corrosion resistant steel and fabricated as per ASME for a vacuum pressure of 760mmHg. It shall include bypass valves, manual drain valves, vacuum gauge. Vacuum reservoir shall have total volume of at least 100 % of primary plant output (+/- 5%) (capacity as mentioned in the tender) in one minute in terms of free air aspired at normal working pressure for systems that have a design flow more than 500 L/min, two receivers should be provided with valve arrangements to permit isolation of one or the other for inspection purposes.

System Controls

The control includes individual self-protected combination MGPS controls with short circuit, single phase and thermal overload protection, individual control circuit transformers with primary and secondary protection, pressure sensors, temperature switches with reset buttons, and an electronic controller to automatically change the operating sequence of the compressors. The system shall have a status display to show the system pressure, elapsed time, maintenance interval, fault conditions, and silence button, lighted Hand-Off- Automatic selector switches and safety disconnect operating handles.

All required local alarm functions shall be integrated into the packaged system. The circuitry shall be designed so that the audible signal can be silenced and the visual indicator will remain until the fault has been cleared and the reset button resets. Local alarm functions shall be annunciate for reserve pump in use

Bacterial Filters

The filters shall be designed for removal of solid, liquid and bacterial contamination from the suction side of vacuum pump systems, preventing damage to the pump and the potential biological infection of the surrounding environment. The dryer shall be particulate filter dryer with ability to remove particles as small as 1micron.

Each individual filter shall have the capacity to deliver full design flow such that one set is designated duty and the other will be standby. Bacteria filters shall have efficiency at least 99.999% when tested by the sodium flame method in accordance with BS 3928:1969/as per required standard utilising particles in the 0.02 to 2 micron size range.

The pressure drop across each clean filter at 50% of the system design flow shall not exceed 25 mm Hg (3 kPa) at a vacuum of 475mm of Hg (63 kPa). Bacteria filters shall be marked with the legend 'Bio-Hazard'.

Each bacteria filter shall be provided with a transparent sterilizable collection jar to collect condensate. The total water capacity of the pressure vessels shall be at least 100% of the design flow rate of the plant in 1minute in terms of free air aspired.

Accessories

Accessories included for job site installation are inlet and discharge flexible connectors, vibration mounting pads, and source isolation valve, inlet check valve, thermal malfunction switch and vacuum control switch. Flexible connectors on inlet and exhaust of each pump, exhaust tee with union as well as copper tubing with Shutoff- cock for gauge/bypass valve and vacuum switch etc.

All the filters shall be covered under warranty period and CMC Period.

Master Electrical Control Panel A dedicated electrical control panel for Air Compressors and Vacuum pumps & Air Dryers, Auto Drain Valves, starter, MCB, ammeter, hours run meter, hand/auto switch, sensors contacts. Under normal conditions the capacity of the plant should be 100% system design flow with one compressor / pump running another one set compressor/pump stand by basis. Integrated with BMS Compatibility and Capable of communicating Master Alarm. Along with automatic sequencing and cascading facility

DISTRIBUTION PIPING

Piping specifications

Copper pipe shall be as per standard BS: EN 13348:2008/ ASTM B819 standards, Solid drawn, seamless, deoxidized, non-arsenical, half hard (hard can be accepted only for sizes 54mm or more), tempered and degreased copper pipe conforming to the standard. All copper pipes shall be degreased & delivered capped at both ends. The pipes shall be accompanied with manufacturers test certificate for the physical properties & chemical composition. Copper pipe must have reputed third party inspection certificate (Eg. Lloyd's or TUV or SGS). Fittings shall be made of copper and suitable for a working Pressure of up to 17bar and especially made for brazed socket type connections. All valves shall be pneumatically tested for twice the working pressure and factory degreased for medical gas service. Copper fittings shall comply with EN 1254:1 factory degreased and brazing filler metals shall comply with EN 1044. Fitting shall be degreased, individually packed for medical use.

The minimum thickness of copper pipes of 35mm and above outer diameter, shall be 1.2mm and the thickness of copper pipes less than 28mm outer diameter, shall be 0.9mm & 12mm outer dia meter shall be 1.0mm as mentioned in respective hospital/ site requirement.

Installation & testing

Installation of piping shall be carried out with utmost cleanliness. Only pipes, fittings and valves that have been degreased and fittings shall be used at site. Pipe fixing clamps shall be of nonferrous or non- deteriorating plastic suitable for the diameter of the pipe.

Inert gas welding technique shall be used by passing oxygen Free Nitrogen Gas inside the copper pipes during silver brazing, in order to avoid carbon deposition inside the copper pipes. Only copper-to-copper joints are permitted on site except threaded or flanged joints may be made where pipelines are connected to items such as valves and control equipment. No flux shall be used for joining Copper to Copper joints and on for joints made on site.

Copper to copper joints shall be brazed using a 5% silver-copper phosphorous brazing alloy CP104. A total of 5 joints shall be cut out for examination to establish the quality of the joints being made on site. The insides shall be clean and free from oxides and particulate matter and the minimum penetration of the brazing alloy at any point shall be three times the wall thickness of the tube. If the joints examined do not conform to these requirements, then adjacent joints shall be cut out and examined until the extent of faulty workmanship has been made good. Copper-to-brass or gunmetal joints shall only be made under controlled conditions off site. The joints are ordinarily used to join short copper pipe tails to brass, gunmetal or bronze fittings to permit their connection into the pipeline. Adequate supports shall be provided while laying pipelines to ensure that the pipes do not sag. Suitable sleeves shall be provided wherever pipes cross through walls / slabs. All pipe clamps shall be non-reactive to copper.

After erection, the pipes are to be flushed with dry nitrogen gas and then pressure tested with dry nitrogen at a pressure equal to twice the working pressure or 150psig, whichever is higher for a period of not less than 24hours.Length and quantity of individual items (Copper pipes, AVSUs, Alarm panels, Isolation Valves, Outlets, Pendants etc.) are to be provided as per the quantity stated in the NIT. For the EPC contract, the complete layout of different items including copper piping needs to be prepared to meet specific site requirement in conformity to the applicable standards and NIT and submitted for approval of the department and execution taken up accordingly thereafter as per the approved design and scheme. Maximum interval between supports (Horizontal and Vertical) (12mm Pipe - 1.0m, 15mm pipe - 1.0m, 22mm pipe – 2m, 28mm pipe-2m, 35mm pipe-2.5m, 42mm pipe -2.5m, 54mm pipe - 2.5m, 76mm pipe – 3meter)

NOTE: The interval between supports should be as per applicable standards.

Painting

All the pipes from manifold/plant up to the outlets shall be painted with two coats of synthetic enamel paint and colour codification shall be as per standards followed and with consultation with competent authorities of the hospital/department.

AREA VALVE SERVICE UNIT with Inbuilt Area Alarm

Area valve service units shall fully comply and meet with HTM 02-01/ ISO 7396-1/ NFPA 99 C. It shall provide a zone isolation facility for use either in an emergency or for maintenance purpose The Area Valve Service Unit shall incorporate pre-fitted ball valve in a box with emergency access. It shall be reliable and easy to operate, easy purge, sample & pressure testing and emergency supply system. Quantity of valves to be worked out and mentioned in the BOQ.

Medical gas/vacuum services shall be fixed copper, piped to and from their respective area valve service units. A color coded service identity label shall be fitted behind the valve handle. The unit shall provide a zone isolation facility. Gas Flow direction shall be indicated. Area Valve Service Unit must have Inbuilt Area Alarm System to minimize space consumption. Area valve Service Unit 2 gas to 6 gas must be in a single box with a lockable door. Separate box for each gas should not be used to save space consumption. Each area

valve must be equipped with pressure gauge and pressure sensor along with gas identification plate. The valve block must be brass and the inlet and outlet in the upward position. The valve lever must be vertical in direction of flow and it must not hinder with the closing of the Valve box door in both Valve ON and OFF position to avoid unauthorized access. It must contain Emergency NIST connection to ensure uninterrupted gas supply during maintenance/service .

Area Valve Box or Zonal Valve Box.

Valve boxes shall be constructed of 18-gauge mild steel/aluminium with powder coated white enamel finish. The valve box shall have a sliding, opaque door with pull ring and clear gauge window. The removable window cannot be replaced when any valve is closed. The frame assembly shall be capable of adjusting for variances in wall thickness up to 1". The window shall conceal piping and mounting screws. Window shall be labelled "Caution Medical Gas Isolation Valves - Close Only in Emergency." Provide clear viewing space in the window to display the gas service, the pressure gauges and the label for areas controlled by the valve. Gas Valve box configuration up to 7 Valves fitting inside the Valve Box. All Medical Gas Valves along with Gauges shall be incorporated with Valve box. All wetted parts (except seals and gaskets) shall be brass or copper. Each unit assembly shall be factory tested for gas tightness. Rubber pipe grommets shall be provided to ensure any leaking gas does not escape from the unit into a wall cavity. All visible aluminium surfaces shall be powder coated.

Shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed .

AGSS (Anaesthetic Gas Scavenging System) Plant

Anaesthetic Gas Scavenging System (AGSS) of minimum 1350LPM as Primary &1350LPM as Standby (or as stated in the NIT based on specific site requirement). It shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed (In-case of NFPA 99c the control panel of Plant must be UL/ETL Listed and Undertaking from manufacturer must be submitted for using the same control panel in the system offered) and shall comply with HTM 02-01/ ISO 7396-1/ NFPA 99 C.

The package shall consist of duplex rotary vane/claw type vacuum pumps or blower as applicable to standards, a control panel with automatic changeover, and mounted on a common base frame.

AGSS pump: Each pump/blower shall be completely cooled and haveabsolutely no water requirements.

The requisite wiring from OTs to AGSS plant for MGPS control/suitable reservoir (as applicable) shall be within the scope of work to be done by the bidder.System in-line non-return values shall allow individual pump servicing. Active anaesthetic gas scavenging systems shall be designed to safely remove exhaled anaesthetic agents from the operating environment and dispose of them to atmosphere from the highest point of the hospital building, thus preventing contamination of the operating department and providing a safe and healthy workspace for the personal. AGSS design shall be dependent upon flow rate and pressure drop characteristics of the individual components of systems. It is essential that

terminal units, MGPS controls (If required) and pump units work in synchronized manner after connection of workstation to the AGSS System.

Installation shall be on roof top/suitable location. Piping, Non-Return-Valves (NRVs), and inlet nozzle shall be suitably placed. Connecting hose suitable to fit with anaesthesia workstation shall be provided.

7.1.5. ALARM SYSTEM

Master Alarm (Digital) (Touch Screen)

Shall be European CE Certified with 4 digit notified body number or American ETL/American UL listed. Complies with HTM 02-01/ ISO 7396-1/ NFPA 99 C Standards and Medical Device Directive 93/42/EEC.

Each Master Alarm shall be modular in design and be fitted with required number of master alarm modules.

The master alarms shall be capable to monitor minimum 40 Point. Each point represents an alarm condition that the source equipment might have. When an alarm condition exists, a red light flashes and the audible alarm sounds. If several alarm conditions occur simultaneously, the most recent alarm light shall flash, while the other alarm lights shall remain lit. When an alarm condition is created, an audible alarm+ shall be actuated. A dry contact module shall be available to interface with a building management system.

The box material shall be of gauge steel of requisite thickness and equipped with mounting brackets. The emissions from alarms shall conform with EMC standards.

Master alarm management system shall be designed to display alarm conditions from the source supply units indicating the broad status of the source equipment and manifolds as well as the master distribution status from the source supplies. Depending on the alarm priority, a visual and audible alarm shall be initiated to indicate an alarm condition.

Each panel shall display and/or input up to forty-point alarms. Panel shall be ready to use with BMS system.

The master alarm must be able to monitor the following source alarm conditions.

- Oxygen Source Empty/Fault
- Oxygen Cylinder Bank Empty/Fault (could be compatible supplied manufacturer of oxygen control panel)
- Oxygen Emergency Bank Empty/Fault - (could be compatible supplied manufacturer of oxygen control panel)
- Air Compressor Faulty/Operation - (could be compatible supplied manufacturer of electrical control panel)
- Vacuum Pump Faulty/Operational - (could be compatible supplied manufacturer of electrical control panel)
- Vacuum Deficiency Vacuum Reservoir
- And Other MGPS Signals & Alarms
- Master alarm shall be integrated with BMS/HIS

Medical Gas Area Alarm

The medical gas central alarms shall be capable of monitoring up to 6 medical gases services (As specified in BOQ of respective institute) by means of pressure sensors which detect deviations from the normal operating limits of either pressure or medical vacuum. The area alarm shall have a digital display of pressures. The medical gas area alarm shall fully satisfy the HTM 02-01/ ISO 7396-1/ NFPA 99 C requirements and shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed.

An audible warning shall sound simultaneously with any failure indication and a mute facility shall be provided.

"It should have each gas service shall be displayed on LCD touch screen Panel. The area alarm should be controlled by LCD display touch screen size minimum 5inch size. An audible warning shall sound simultaneously with any failure indication and a mute facility shall be provided. Following a mute selection, the audible will resound after approximately 15 minutes or shall operate simultaneously should a further alarm condition occurs. A “Mute” switch shall be provided inside the panel for use during any maintenance resulting in prolonged pipeline or plant shutdown. This facility shall automatically reset when the gas service returns to normal. The alarm panel shall have a 'Test' facility to prove the integrity of the internal circuits, visual and audible warning. The alarm panel shall incorporate a volt free normally closed relay to allow for interconnection to either a medical gas central alarm system or an event recording circuit of a building management system. In the event of an electrical power supply failure the 'System Alarm' LCD panel shall illuminate (flashing) and the audible warning shall be delayed for 30 seconds to enable standby generator tests. Line continuity monitoring circuits shall be provided to constantly monitor the integrity of the input sensors and interconnecting wiring. In the event of any fault the line continuity monitoring circuits shall initiate the specific gas service failure indication, a 'System Alarm' indication and an audible warning. Further aids to fault diagnosis shall be provided by means of varying flashing rates whilst operating the 'Test' switch. It should be connected through Pressure and Vacuum Switches: Pressure and vacuum switches shall be manufactured with brass wetted parts and house a PCBA with line continuity monitoring resistors. Electrical connectors shall be designed for frequent disassembly. Spade connectors are not acceptable. Pressure switches shall include both high and low-pressure settings in the same switch. The body and housing of the pressure switch shall be manufactured from impact resistance, rigid and inherently corrosion proof materials. Pressure switches shall connect directly to the area alarm panel. It is not acceptable to fit a separate connection box to convert switch signals to a data signal. Each gas service shall be displayed by coloured LEDs to show 'Normal' (green), 'Low' and 'High Pressure' (red) conditions. Medical vacuum systems shall be displayed in the 'Normal' (green) and 'Low Vacuum' (red) conditions only. Failure indicators shall be displayed by flashing lights and normal indications shall be steady. The emissions from alarms should conform with EMC standards or as per guideline of standard to be followed. All MGPS warning and alarm indicating panels, including all operating room panels should comply with the requirements of specific standard as mentioned herein/ NIT.

GAS OUTLETS

Terminal Units (Gas Outlets) with probes/Adaptors for O2, N2O, Compressed Medical Air 4, Surgical Air 7, AGSS, Vacuum & CO2 (CO2 can be optional depending on the requirement).

Terminal units installed in walls, bedhead trunking, headwalls or fixed pendants shall be connected to the pipeline with a copper stub pipe. Pressure gases and shall incorporate a 12mm O/D copper stub pipe. Terminal units for vacuum and anaesthetic gas scavenging shall incorporate a 15mm O/D copper stub pipe. These terminal units must be in two fixes to have valve assembly.

Each terminal unit shall consist of a primary valve (or assembly) and shall be permitted to include a secondary valve. The secondary valve shall close automatically to stop the flow of gas (or vacuum, if provided) when the primary valve is removed.

Front Loading Type Terminal Outlets shall be designed to dispense medical gases (or an inlet for medical vacuum) to the secondary equipment (flow meters, Suction regulators, etc.) at the point of use and is gas specific so that secondary devices cannot be “attached” to the wrong gas. When not in use the gas in a non-flowing state within the Outlet (Terminal unit) sealed by “O” ring. The adapter when inserted pushes the poppet inside and the gas starts flowing and sealing is ensured by the “O” ring or a seat. The Outlets are Quick Connect Type and gas specificity is accomplished by "Pin indexing." The outlets shall have following features:

- Push to insert and press-to-release mechanism for probes.
- Allows plugging of probes from front.
- Self-sealing valve on disengaging the probe (Quick disconnect)
- Smooth quite action.
- Non return valve for on line servicing/ repairing
- Indexed to eliminate inter-changeability of gas services
- Color-coded gas specific front plate
- Totally leak proof, safe & easy to operate
- Configurations possible: surface, flush & Bead-head.
- Outlets shall be European CE Certified with 4 digit notified body number or AmericanETL/American UL listed
- All outlets shall have respective labels (i.e.O / N O / CO / Air4 /Air7/Vacuum/AGSS/etc.) displayed accordingly.

The medical gas terminal units shall conform to BS EN ISO 9170-1 and accept probes toBS5682. Terminal units shall be capable of single-handed insertion and removal of themedical gas probe. The anaesthetic gas scavenging (AGS) terminal unit shall conform toBs6834.

OR

Terminal units conform to gas specific dimensions and connection requirements stated in DIN 13260-2. Components are designed and manufactured in accordance with BS EN ISO 9170 for medical gas distribution systems. Terminal units installed in walls, bedhead trunking, headwalls or fixed pendants shall be connected to the pipeline with a copper stub pipe. Pressure gases and vacuum shallincorporate minimum 12mm O/D or more copper stub pipe. Terminal units foranaesthetic gas scavenging shall incorporate minimum 15mm O/D

copper stub pipe.

Medical gas terminal units consist of two parts: First fix – the wall mounted assembly consists of brass pipeline termination block with copper stub pipe secured between back plate and a gas specific plate to allow 130 degrees radial movement of the copper stub to align with the pipeline. The second fix components shall be manufactured with the pin index permanently moulded into the gas specific socket. The socket assembly shall retain a capsule assembly, containing the check valve and probe 'O' ring seals.

Second fix terminal units shall be supplied with the anti-rotation pin loose and bagged to be fitted as required. The socket is fixed to the base block with a design that ensure profile is always in the correct position. Probes are gas specific connectors that couple to the medical gas terminal unit sockets to provide access to gas systems. The replaceable capsule assembly shall enable all working parts subject to wear through usage to be replaced as a factory tested assembly, thereby reducing maintenance time. Each termination block assembly shall be pressure tested by the pressure decay method.

BED HEAD PANEL

The design shall be approved by the respective hospital authority/ department before installation and it is responsibility of the bidder after getting order they have to interact with respective hospital authority/ department and finalize the Bed Head Panel (Horizontal) as per site condition. Level and all outlets and sockets shall be located at a height of 1475-1550 mm from FFL, as per the site conditions. Horizontal BHP shall be of maximum 1200mm for 2 Gas outlet configuration, maximum 1500mm for up to 3 &4 outlets configuration and maximum 1800mm for 5 & 6 Outlet configurations

It shall have following features: -

Efficient, Safe & Robust design in extruded aluminium section.

Smooth curved surfaces, and choice of base colour and fascia plates.

Unit shall have integrated rail system to mount accessories

The headwall system shall be constructed of aluminium extrusions joined together to form a carcass to suit the particular application. Unit shall be factory assembled for electrical and mechanical components.

Segregation of services i.e. Low voltage supplies, High Voltage supply and Medical gases shall be maintained with minimum 2 tier, 2/3 channel arrangements with built-in LED Lighting (with ON/OFF control) Shall be European CE Certified with 4 digit notified body number or American ETL/American UL listed. Front fascia plate shall be removable individually to access for respective service.

It shall have one rail for mounting Accessories.

Each bed-head unit shall be supplied with cut out provision of electrical sockets, nurse call system, Data and Voice system.

Shall have per unit as under :

- Oxygen – 2

- Vacuum – 2
- Medical Air-1
- Holder for vacuum collection jar –1
- Cut Out provision for Nurse call switch – 1 (sample to be provided nurse call vendor)
- Cut out provision for 5/15A combined Electrical socket with switch – minimum 4 Nos. with 2 outlet combination, 6 Nos. with 4outlet combination and 8 Nos. with 6/8 outlet combination
- Cut out provision for RJ-45 socket/ Ethernet -01
- Two spare spaces with dummy plates.

NOTE: Above provisions may vary which is subject the site conditions and client's requirement.

WARD VACUUM UNITS (Other than ICU Area)

It must consists of the following:-

- 1no of Suction Regulator and 1no of 600 ml polysulfone /polycarbonate collection jar.
- Suction regulator (Digital/Analogue): Suction regulator shall be supplied with a safety jar, including and antibacterial filter and an anti-overflow safety device. Shall have wide membrane continuous suction controller.
- Shall have vacuum levels: 0-750 mm Hg or more Shall have vacuum gauge fitted with a protective bumper device.
- Shall have on/off knob allowing for the quick restoration of a readjusted vacuum level.
- Must have central adjustment knob with a colour coded for 0 to 750 mm Hg or more. Shall have Polysulfone/ polycarbonate 100cc safety jar, autoclavable at 121º C at 5mins, unbreakable, fitted with an anti-overflow safety device and equipped with antibacterial filter. It shall be totally transparent, to ensure perfect sucked liquid visibility.
- Low flow ward vacuum unit - Shall have vacuum levels: 0-150 mm of Hg ± 10%

Ward Vacuum Units (for ICU area)

It must consists of the following:-

- 1no of Suction Regulator and 1no of 1000 ml polysulfone /polycarbonate collection jar.
- Suction regulator (Digital/Analogue): Suction regulator shall be supplied with a safety jar, including and antibacterial filter and an anti-overflow safety device. Shall have wide membrane continuous suction controller.
- Shall have vacuum levels: 0-750 mm Hg or more.
- Shall have vacuum gauge fitted with a protective bumper device.
- Shall have on/off knob allowing for the quick restoration of a readjusted vacuum level.

- Must have central adjustment knob with a color coded for 0 to 750 mm Hg or more.
- Shall have Polysulfone/ polycarbonate 100cc safety jar, autoclavable at 121º C at 5mins, unbreakable, fitted with an anti-overflow safety device and equipped with antibacterial filter. It shall be totally transparent, to ensure perfect sucked liquid visibility. Low flow ward vacuum unit - Shall have vacuum levels: 0-150 mm of Hg ± 10%

Theatre Vacuum unit for OT

It must consist of the following: -

Suction Regulator (Digital/Analogue) and 2nos. 2000ml or more polysulfone/polycarbonate collection jar and both to be mounted on a trolley.

Shall be European CE Certified with 4 digit notified body number or American ETL/American UL listed.

In case of digital suction regulator, battery shall be replaced by the bidder during warranty & CMC period.

Theatre Suction Trolley

Theatre Suction Trolley shall be Certified as per Class I of Medical Device Directives(93/42/EEC) & CE marked. It should be manufactured in an ISO 13485:2003 quality management system duly certified constructed in accordance with the requirement of international standard. It will be trolley mounted. The unit will include one regulator having gauge and mounted on the trolley stand, having two reusable each 2000 mlplastic collection bottles mounted on the base of trolley unit and connected with regulator & low pressure tube inter-connections. Safety Jar 200 cc to be provided with regulator. The collection jar is made of unbreakable material, which is fully auto cleavable at 121 Degree Centigrade. The jars shall be mounted on Stainless Steel Trolley (SS304 material) having four (4) free moving castor wheels, with a stablebase design and an easy grip handle.

Suction Regulator: Suction regulator shall be supplied with a safety jar, including ananti-bacterial filter and an anti-overflow safety device. Shall have wide membrane continuous suction controller.

Shall have vacuum levels : 0-750 mm of Hg or more.

Shall have vacuum gauge fitted with a protective bumper device. Shall have on/off knob allowing for the quick restoration of a readjusted vacuum level.

Shall have polysulfone/ polycarbonate safety jar, auto clavable at 121º C, unbreakable, fitted with an anti-overflow safety device and equipped with antibacterial filter. Collection jar shall be totally transparent, to ensure perfect sucked liquid visibility.

Medical Gas Shut of Valves or Line Ball Valves or Isolation Valves

The line valves must be degreased and complete valve with stuffed pipe & fittings, factory tested and compliant with applicable standard.

a) All Medical Gas Valves shall be specially prepared for oxygen service and shall conformto latest international standard. Valves shall be ball-type, with Teflon seats and adjustingstem packing gland with Teflon stem seal.
b) Ball Valves shall operate from the fully open to the fully closed position by manual operation of a lever through 900. Valve nominal bores shall be equal to the nominal pipework size.
c) Furnish and install only valves with factory brazed Copper stub pipes shall be manufactured from medical grade copper pipe to BS EN 13348:2001 which should be Lloyds/SGS/TUV/DNVGL certified or any accredited third-party certified agency.
d) Ball valve shall be provided with locking handles.
e) All valves shall be cleaned for oxygen, capped and sealed in a polyethylene bag for shipping and storage.
f) Apply labels to each valve in the assembly for gas service identification according to manufactures recommendations.
g) Medical gas line ball valve assemblies shall be constructed in a two-piece full-bore design with brass body, Teflon ball seals, stem packing seal, stem 'O' ring seal and a hard chrome plated brass ball valve.
h) Ball Valve sizes 15 to 54mm inclusive shall have flat-face connectors with 'O' ring seals.
i) The 76 to 108mm inclusive shall be flanged and installed with stainless steel bolts, nuts and spring washers with sealing gaskets. PTFE tape or any other thread sealing media is not acceptable.
j) All Medical Gas Valves should be factory tested and certified from OEM. Performance reports (Valve Size, Torque, Working pressure and material certification) has to be submit by the bidder on behalf of OEM.

High Pressure Tubes for Oxygen, Compressed Air & Vacuum

It shall be colour coded for individual services i.e. white for Oxygen, Blue for N2O and Yellow for Vacuum, Black for air. Antistatic rubber tube shall be as per ISO standards. It shall be Shall be European CE Certified with 4 digit notified body number or American ETL/ American UL listed. (The 200m Hose- Gas wise requirement shall be taken from respective institute before supply total lengths shall be 200m inclusive of all type. If institute requires more than payment will be made on actual basis asper finalized BOQ rate)

Interconnection to LMO Tank

Price shall be quoted per meter basis or as per scope defined in the NIT. The scope shall be inclusive of all installation, material (Copper Pipes, fittings, etc.), trenches and labour etc. charges as per site condition. The payment shall be made as per the conditions defined in the NIT. Items for LMO interconnections already covered in the BOQ

Extra/ Other essential items to be covered in NIT as per actual requirement at site.

- Bidder shall co-ordinate with respective hospital authorities/ department for the finalization of required Office/ Control Room for & Toilet for MGPS maintenance staff into Manifold/Plant Room.
- Bidder shall assist in for all civil modifications and repair for successful completion of MGPS Plant, Manifold, and Pipeline installation and commissioning throughout the proposed blocks/buildings by providing need based inputs.
- Bidder will assist to hospital for internal walls/partitions & doors for creating separation between MGPS Plant and Manifold room, etc. as per site requirement by providing need based inputs/layout drawing

Anaesthesia Pendant – Rigid with Bottom Swelling

- Weight Loading Capacity - 150Kgs.
- Bearing Topper Roller imported.
- Aluminium Ceiling Cover.
- Vertical piping seamless steel.
- Console Extruded 4mm Aluminium Alloy
- Tray Extruded Aluminium Alloy Loading Capacity - 50Kgs.
- Aluminium fabricated drawer sheet.
- SS 304G IV Pole.
- Leak tested high pressure piping.
- 340degree arm rotation.
- Console rotation 330degree.
- Electricals up to 10Nos.
- Poly powder coating.
- Medicine Basket.

Surgeon Pendant – Single & Double Arm

- Surgeon Pendant - Single Arm
- Weight Loading Capacity - 150Kgs.
- Bearing Topper Roller imported.
- Aluminium Ceiling Cover.
- Arm Extruded 11mm Aluminium 11mm Alloy
- Arm end covers with ABS Plastic.
- Vertical piping seamless steel.
- Console Extruded 4mm Aluminium Alloy
- Tray Extruded Aluminium Alloy Loading Capacity - 50Kgs.
- Aluminium fabricated drawer sheet.
- SS 304G IV Pole.
- Leak tested high pressure piping.
- 340degree arm rotation.
- Console rotation 330degree.
- Electricals up to 10Nos.
- Pneumatic braking system.

- Poly powder coating.
- Ceiling metal rod and service plate.
- Console Length 800mm*1000mm

Comprehensive Maintenance

- The Contractor shall be responsible for defect liability, OEM warranty of products and comprehensive maintenance of MGPS installations for ten years (5 years warranty plus 5 years CAMC) from the date of completion of the work through the same MGPS firm.
- The MGPS firm shall be approved on the basis of work experience as per provisions of eligibility described in the CPWD Works Manual/ Chapter 1 para 4 of this specification.
- The comprehensive maintenance of MGPS installations includes complete MGPS installations, labour, spares, all consumables etc. as required including the following.
  - **a)** All MGPS equipment mentioned in the NIT.
  - **b)** Plastic and glass parts against any manufacturing defects.
  - **c)** All kinds of sensors.
  - **d)** All kind of coils, probes and transducers.
  - **e)** All kinds of painting, MGPS related areas (as executed by firm).
  - **f)** Preventive maintenance including testing & calibration as per technical/service/operational manual of the manufacturer.
  - **g)** MGPS installation inside the MGPS plant room/yards.

Note: Check for the requirement of spares and consumables in the system. The NIT authority can list these consumables on paid basis also on actual consumption, as deemed fit, for which suitable items needs to be incorporated in the BOQ.

- In the case of MGPS equipment, the comprehensive maintenance shall be done with back-to-back support from OEM. In such cases, authorized agent of OEM shall reach the site within 24 hours of raising a service call.
- The MGPS firm shall ensure uninterrupted service without compromising functioning of MGPS/ICU.
- The MGPS firm shall set-up a maintenance base in the vicinity of the hospital, to provide maintenance service of the entire MGPS installations.
- If the performance of any individual equipment or system is not satisfactory, the same shall be replaced free of cost.
- If it is found that to meet the performance criteria, any extra equipment is required, the same shall be provided free of cost.
- All faults and their rectification shall be promptly intimated to the hospital.
- Any lacunae noticed in the functioning of the installation as a result of any design feature shall be rectified free of cost.
- Proper marking has to be made for all spares for identification like printing of installation and repair dates.

- On receipt of any complaint, the MGPS firm shall, within 8 hours on a 24(hours) X 7 (days) X 365 (days) basis respond to take action to repair or replace the defective goods or parts thereof free of cost. The MGPS firm shall take over the replaced parts/goods after providing their replacements and no claim, whatsoever shall lie on the hospital/institute for such replaced parts/goods thereafter. The penalty clause for non-rectification will be applicable as per tender conditions.
- Upon failure of the MGPS firm to respond to take action to repair or replace the defect(s) within 8 hours on a 24(hours) X 7 (days) X 365 (days) basis, the hospital/institute may proceed to take such remedial action(s) as deemed fit by the hospital/institute, at the risk and cost of the Contractor without prejudice to right of Government to take other remedial actions under the agreement.
- If the MGPS firm fails to attend the complaint with in 8 hours a penalty of Rs. 5000/hour will be charged from the firm and recovery made accordingly. The decision of the The Engineer shall be final and binding on the firm with respect to the imposition of overall penalty decision taking into view overall circumstances of the case.
- The Contractor/MGPS firm along with the Indian agent of the manufacturer shall ensure continued supply of the spare parts for the machines and equipment supplied by them for 10 years from the date of completion of the work.
- The payment of comprehensive maintenance will be made on six monthly basis after satisfactory completion of said period duly certified by end user.
- The Contractor shall ensure regular updates of newer technology as and when evolved during warranty period for all the equipment.
- There shall be no extra cost for software upgradation/ supply and installation of security patches/ lifetime license fee for system (if and as required for MGPS system). The software upgradation including security patches shall be provided free of cost during the CAMC period. Bidder should submit OEM certificate to the effect that the software as well as security patches etc. shall be made available for enabling free upgradation of the system till the expiry of the defect liability period and CAMC period. The software validity shall be till the end of the CAMC period and will be got done by the OEM/through their authorised channel partners within the tendered cost."

MAKE IN INDIA POLICY

The MGPS work shall fully comply to Public Procurement (preference to make in India). Order (PPP-MII order) 2017 issued by DPIIT and corresponding notifications issued by concerned nodal ministry/department as amended up to the last date of receipt of tenders.

Notes

- Necessary modifications may be made in the additional conditions by the NIT approving authority as per actual requirements at site and/or to safeguard government interest.
- It is advised not to stipulate makes of materials/equipment in the NIT. The makes which conform to the specifications in NIT may be accepted.

- It is advised that procurement, installation, testing and commissioning of the MGPS medical equipment may preferably be included in the scope of EPC/composite contract in hospital projects by indicating minimum benchmark levels and related specifications.

7.2.NURSE CALL SYSTEM (NCS

7.2.1. SCOPE OF WORK

1.1. The Hospital Call System is the communication system in which the Nurse Call System including nurse call and emergency call are operated and managed in an integrated way. It aims to increase the performance and quality of hospital services by providing call and information infrastructure between healthcare personnel and patients. Clear definitions of these systems follow:

1.2. Nurse Call is the communication system allowing patients to call nurses from their rooms, patient toilets and bathrooms. The origin locations of these calls (room, bed if applicable) are indicated by Over Door Lights, and sent to the nurses as alerts on Nurse Control Panels. It increases the quality of the services provided by nurses by allowing the patients to reach the nurses quickly and easily when they are in need, while also reducing alarm fatigue experienced by nurses through intelligent call routing; the calls can be configured to go to any specific nurse or group of nurses depending on the call type or location.

1.3. Code Blue System allows personnel in the hospital to initiate Emergency Code Alarms when Cardiopulmonary resuscitation (CPR) is required in the hospital from the points decided by the institution. The system sends the origin to the responsible team.

7.2.2. GENERAL FEATURES

1. All devices and materials that constitute the system shall be new and standard products. The products used must not have an EOL (End of Life) announcement declared. The company will commit to continue production of all devices and components used in a system for a minimum of 5 years after the implementation of the system.
2. Equipment shall be placed according to types of patient bed areas, location of nurse desks and architectural parts within the hospital. A patient handset shall be placed with each bed in the hospital and each short stay unit in emergency service unit.
3. A pull-cord call unit shall be placed in every WC/bathroom used by patients in the hospital.
4. A nurse control panel in-ward nurse panel shall be placed on service nurse desks to be designated. The panel shall be located in a place that attracts attention, provides readability and is accessible by touching the screen in the event of audible and visual alerts. The Nurse Control Panel shall be able to make VoIP calls to other VoIP enabled devices within the nurse call system.
5. A Code Blue Call unit shall be placed in every location the institution requires. Room Control Units shall be used for initiating Code Blue Call where they are

placed.

6. A Room control unit shall be placed in every private and semi-private room to ensure nurses as VoIP terminals, nurse routine check and emergency authorization points with built-in card readers.
7. A Zone Controller shall be placed in locations where multi bed wards and their associated shared bathrooms can have connectivity with the rest of the system.
8. An IP system controller will be placed for each hospital with an appropriate room capacity to configure, manage and maintain the entire system.
9. All device connections inside and outside the room shall be made with standard Cat6 UTP cable. Terminations shall be RJ45 with international standard B type connection.

7.2.3. PRODUCTS

GENRALS

Nurse Call System consists of Zone Controllers, Over Door Lights, Patient Handsets, Bedside Call Units, Code Blue Call Units, Pull-cord Call Units, Nurse Control Panels, Ward Nurse Stations, Room Control Units, Personnel Smart Cards and IP System Controller with software designed to perform the jobs with properties stated above as well as keep detailed call logs of calls and display these logs in meaningful graphical reports to be filtered by parameters such as date, call type, and area.

7.2.4. ROOM CONTROL UNIT

- The Room Control Unit shall have a structure capable of controlling the call system within each private and semi-private room. It shall be used one for each Private and semi-private patient rooms as the connection point for in room devices in that particular room.
- Room Control Units shall send all calls and system information including timestamps and origin addresses for all Bedside Call Units, patient handsets, and Pull-cord Call Units within the room, to the IP system controller using IP.
- Room Control Units shall have hands free full duplex SIP VoIP speech communication support.
- Voice calls made over the Room Control Unit shall be able to be recorded over the IP System controller based on request. These records shall be able to be reviewed on the logs of the System controller interface.
- Room Control Units shall be able to work directly with a Nurse Control Panel without any issue if there is lost connection with the IP System Controller.
- The Room Control Unit shall have eight RJ45 Call Unit ports to support both Bedside Call Units and Pull-cord Call Units. These ports shall also support the assignable indicator lights.

- The Room Control Unit shall have one RJ45 Over Door Light port. This light will be used as the rooms activity indicator in the corridor installed over door.
- The room devices shall be able to be monitored on the Room Control Unit. The main screen of the room control unit shall show which patient made the call.
- The unit shall be flush mounted on the wall.
- The Room Control Unit shall perform general nurse call functions by reading personnel smart cards, initiating and terminating Blue/White/Red/Pink Emergency Code calls, Assist Calls and Nurse Presences and giving visual and audio alerts about the call status.
- Room Control Units shall have a built-in RFID card reader to identify personnel smart cards, preventing intervention of unauthorized persons, and when a healthcare personnel use their smart card on the panel, their name shall appear on the screen. Nurses responding to nurse calls shall note that they have arrived in the room by holding their card to the Room Control Unit's built-in RFID card reader.
- The built-in RFID shall be capable of reading smart phone NFCs. This shall be able to be configured to work as replacement for smart cards for permissions checks and ID logging.
- Room Control Units shall have an LCD TFT touch screen of at least 5". The screen shall show the information about the active calls in the room.
- There shall be an Emergency Codes menu with buttons for different emergency calls and these buttons shall only be able to be used by activation via personnel card. Without using a personnel card, no call shall occur even if these buttons are touched.
- The Room Control Unit shall have a default screensaver showing the current date and time.
- Nurses shall have the option perform routine observation procedure by signing into the room when there is no active call by any patient. The Over Door Light shall remain green for as long as the nurse is present in the room (as while responding to regular calls), and shall turn off when the nurse signs out of the room with her card.
- The Power supply of the Room Control Unit shall be PoE.
- When the nurse enters the room, the presence information shall be applied to update the status of all active calls within the room.
- Room Control Units shall be IP based and each room shall be connected to the network through an independent ethernet line. Each Room Control Unit shall have an independent IP address.
- The Room Control Unit shall allow calls from other rooms to appear on the Room Control Unit Screen when there is a Nurse Presence in the room.
- The settings menu of the Room Control Unit shall allow the reconfiguring of how many bed call units and WC call units are connected, as well as renaming them.

- The settings menu of the Room Control Unit shall also allow reconfiguring of the behavior of the attached Over Door Light, such as light color and blinking/non blinking status.
- The settings menu shall only be accessible with authorized cards.
- Device connections inside and outside the room shall be made with standard Cat6 UTP cable. Terminations shall be RJ45 with international standard B type connection.

7.2.5. ZONE CONTROLLER

- This is the main node device used to network the Nurse Call System devices to each other for areas are not private or semi-private rooms and do not have item 3.2(Room Control Unit). It is to be used for multi-bed wards areas in a single open space with a nurse desk overlooking the assigned patient beds.
- Each Zone Controller has 2 communication ports which support chains of up to 24 call initiation devices each, and up to as many over door lights as the number of call initiation devices, for a total maximum support of 48 call devices.
- The connection shall be made with Cat 6 UTP cable and RJ45 of B standard. Total cable lengthfrom the Zone Controller to the last call device cannot be longer than 500 meters for each communication line on each communication port.
- Zone Controller shall have 2 power injectors to be included with the device to be used for injecting 12V power to be used on each communication line. Each power injector has 2 RJ45 ports to be connected at suitable locations to prevent voltage drops on the lines. Each power injectors require 110-240 V power.
- There shall not be any limits to the number of Zone Controllers that can be used in a Nurse Call System, they may be placed in the network as necessary to extend the system.
- The Zone Controller shall have 1 uplink data port which is connected to the hospital network switch. Its connection shall be made with Cat 6 UTP cable and RJ45 of B standard.
- The Zone Controller shall have 1 port for 110-240 V power.
- The Zone Controller must be configurable from the IP System controller.

7.2.6. OVER DOOR LIGHT

- Over Door Lights shall use environmentally friendly LEDs
- It shall consist of red, green, and blue colored warning lights.
- In normal condition, no light shall be lit. If the patient makes a nurse call, a red light shall be lit within 0.5 seconds. After the nurse call, when the nurse presses the green presence button on the Call Unit, the light of the Over Door Light will turn green.
- In Code Blue, the blue light shall be lit.

- The outer casing of the Over Door Light shall be made of non flammable PC-ABS-FR materials.
- Over Door Light shall have 2 Input / Output ports for RJ45 endings for cabling in a chain with call units on one of the communication lines of the Zone Controller? Alternatively, it connects to the Room Control Units in private, semi-private rooms.
- Its connection shall be made with Cat 6 UTP cable and RJ45 of B standard.
- This device shall be powered by the Zone Controller or black colored communication ports of Room Control Unit to which it is connected. It shall not require additional energy supply.
- A single RJ45 Output port version of the unit shall be available to connect to Room Control Unit through yellow colored room indicator port dedicated only for use of this alternative version of the Over door light.

7.2.7. BEDSIDE CALL UNIT

- The Bedside Call Unit shall be mounted on headboards where there are patient headboards or on the walls where it can be implemented within the system.
- The Bedside Call Unit has 2 Input/Output ports for RJ45 endings for cabling in a chain with Over Door Lights and other call units and eventually to one Zone Controller. Alternatively connects to the Room Control Units in private, semi-private rooms.
- On the standard Bed Side Call Unit front side there shall be; A “start call” button with a red nurse symbol. An “end call” button with a green tick mark symbol. Reassurance backlight in order to give visual information about the call status. Continuous backlight for easy visibility of the unit at night. Pressing on the End Call button ends the call and turns the assigned over door light to green. IP System Controller logs the event as “Presence”.

Pressing the End Call button for the second time ends the “Presence” and turns off the assigned Over door light.

- The Bedside Call Unit shall be made from non flammable PC-ABS-FR materials.
- It can be used individually as a call button where patient handset is not needed. Otherwise, its connection with the patient handset shall be easily established by connecting via RJ45 on its front side.
- A nurse call shall be initiated via the patient handset or the Bedside Call Unit. These two buttons shall be accepted by the system as equivalent. In the event that these buttons are pressed:
- If the unit is able to transmit the call to the zone controller, the LED on the unit shall flash with 1.0-second intervals. Call transmission information shall be audibly notified to the patient.
- If there is an error in call transmission, a continuous red light showing the error status shall only stop when the call termination button is pressed or room

control connection is made. Subsequent presses of the button shall trigger an audio alert each time.

- Its connection shall be made with Cat 6 UTP cable and RJ45 of B standard.
- This device shall be powered by the Zone Controller or black colored communication ports of Room control unit it is connected. It shall not require additional energy supply.

7.2.8. CODE BLUE CALL UNIT

The Code Blue Call Unit shall be mounted on headboards where there are patient headboards or on the walls where it can be implemented within the system.

- The Code Blue Call Unit has 2 Input/Output ports for RJ45 endings for cabling in a chain with Over Door Lights and other call units and eventually to one Zone Controller. It also connects to the Room Control Units in private, semi-private rooms.
- On the Code Blue call unit front side there shall be; A “start code blue” button with a blue medicine symbol. Pressing the button initiates a Code Blue event, turning on the assigned Over door lights to Blue.
- An “end code blue” button with a green tick mark symbol. Pressing the Button shall cancel the Code blue alarm turning the assigned Over door lights.
- Reassurance backlight in order to give visual information about the call status. Continuous backlight for easy visibility of the unit at night.
- The Code Blue Call Unit shall be made from non flammable PC-ABS-FR materials. If the unit is able to transmit the call to the zone controller, the LED on the unit shall flash with 1.0-second intervals. Call transmission information shall be audibly notified to the patient.
- If there is an error in call transmission, a continuous red light showing the error status shall only stop when the call termination button is pressed or room control connection is made. Subsequent presses of the button shall trigger an audio alert each time.
- Its connection shall be made with Cat 6 UTP cable and RJ45 of B standard.
- This device shall be powered by the Zone Controller or black colored communication ports of Room control unit it is connected. It shall not require additional energy supply.

7.2.9. PATIENT HANDSET BASIC

This handset will be used in locations that are connected to the system by a Zone Controller.

- It should be ergonomically designed for handheld use and connected to the Bedside Call Unit with an independent cable. On its front side, there should be:

  - A "start call" button featuring a red nurse symbol.

- A reassurance LED light to provide visual information about the call status.

- A continuous LED light for easy visibility during nighttime.

- Call initiation and error notification procedures is the same as Bedside Call Unit except audio alerts are always issued by the Bedside Call Unit. Its call initiation button and call backlight work in parallel with the ones on the Bedside Call Unit.
- It shall have an easily cleanable surface that does not promote bacterial growth.
- Patient handset shall be made from nonflammable PC-ABS-FR materials.

7.2.10. PATIENT HANDSET PRO

- This handset shall be used in locations that are connected to the system through a Room Control Unit. This handset shall have a membrane keypad promoting extra sanitation. Its buttons shall be satisfying to press and responsive.
- This handset shall include an IR remote control, which shall be able to be synchronized with any remote control for any device. The buttons to be synchronized are marked for on/off, volume up, volume down, mute, channel up, channel down.
- There shall be a call button for the patient to initiate a call. There shall be two alternative buttons to control lighting. The handset shall be connected to a Bedside Call Unit with RJ45.
- New televisions shall be configurable to be compatible as the hospital changes them.
- Patient handset shall be made from non flammable PC-ABS-FR materials.

7.2.11. PULL-CORD CALL UNIT (WC/BATHROOM):

- The Pull-cord Call Unit has 2 Input/Output ports for RJ45 endings for cabling in a chain with Over Door Lights and other call units and eventually to one Zone Controller. It also connects to the black colored communication ports of Room Control Units in private, semi-private rooms.
- On its front side, there shall be:
- A call pull-cord with customizable length with minimum 1.5 meters to serve as a call-cord.
- A call termination button (indicated by a green tick mark symbol)
- Its connection shall be made with CAT6 UTP cable and RJ45 of B standard.
- A priority WC Emergency Call shall start when the cord is pulled.
- This device shall be powered by the Zone Controller or black colored communication ports of Room control unit it is connected. It shall not require additional energy supply.

7.2.12. NURSE CONTROL PANEL

- The Nurse Control Panel shall be put on Nurse Stations responsible for covering the need of private and semi-private patient rooms that is controlled by a Room Control Unit.
- The Nurse Control Panel shall have a minimum 7" touchscreen and include its own integrated phone handset. It shall have Android OS.
- The Nurse Control Panel shall be usedfor monitoring the status of every assigned room, including device errors and call and alarm status.
- The origin room and bed information of all active nurse calls, emergency code calls, assist calls, and nurse presences shall be shown with an audiovisual alert along with the call type.
- Onscreen call points shall have notifications of relevant icons, colors, and tones according to their call status.
- Calls shall be shown simultaneously, and icons showing the emergency calls shall shake and otherwise draw attention over icons showing regular calls.
- When a nurse is present in a room, the nurse presence in that room shall be displayed; when a call is cancelled, the call alert onscreen shall be cancelled.
- Timestamp and error logs for situations when the energy supply of the panel is cut or there is no network connection shall be recorded on hospital call System controller and shall be automatically sent to relevant technical personnel's pagers and/or Android-based smart phones as error messages.
- If a call on the nurse panel is not responded to within a determinable amount of time, the call shall automatically be forwarded to other nurse panels. Panels shall be configurable to function as mirror panels either manually or automatically based on time of day.
- There shall be voice call feature between the panels.
- The panel shall be structured to allow speech communication with any Room Control Unit.
- If a panel needs to be changed, the new panel only needs to be given the old panel's IP information, and this shall be enough to configure the panel. The other settings shall be automatically configurable from the System controller.

7.2.13. WARD NURSE STATION

- The Ward Nurse Station shall be used in locations that are connected to the system by a Zone Controller. It is placed in each multi-bed ward area at the nurse station overlooking the patent beds.
- The Ward Nurse Station shall have a minimum 10" touch screen and include its own integrated handsfree voice communication with other Nurse Control Panels.
- The Nurse Control Panel may be used to monitor the status of every assigned call point's call and alarm status. The screen will show active calls and emergency code with top to bottom priority, highest priority active call is on top and longest awaiting call within same call type having more priority than same type.

- The origin room and bed information of all active nurse calls, code blue calls shall be shown with an audiovisual alert along with the call type.
- Onscreen call points shall have notifications of relevant icons, colors, and tones according to their call status as well as time the call started and time passed since.
- Calls shall be shown real-time. Each activity will be send to IP System Controller for logging enabling later inspection and reporting.
- Timestamp and error logs for situations when the energy supply of the panel is cut or there is no network connection shall be recorded on the IP System Controller.
- If a call on the nurse panel is not responded to within a determinable amount of time, the call should be able to automatically be forwarded to other nurse panels. Panels can also be set to function as mirror panels either manually or automatically based on time of day.
- If a panel needs to be changed, the new panel only needs to be given the old panel's IP information, and this shall be enough to configure the panel. The other settings can be automatically configured from the IP System Controller.
- The panel should have 1 port for 110-240 V power.
- Emergency codes Blue, Red, Pink and White shall be initiated from the touch screen.

7.2.14. CENTRAL MONITORING SOFTWARE

- The Central Monitoring Software is a web-based monitoring software able to be viewed from a computer or smart screen, typically placed in a central location.
- The Central Monitoring Software shall display real time status of all or selected call types originating in all or selected areas of the hospital.
- The Central Monitoring Software shall display these calls with icons and colors indicating their type. The time elapsed since the initiation of the call and the timestamp of the call shall be visible.
- Nurse and Personnel presences shall be displayed on a separate part of the screen.

7.2.15. IP SYSTEM CONTROLLER SOFTWARE AND HARDWARE

- The IP System Controller shall be planned as a structure to operate without interruption and with backup.
- The IP System Controller interface shall include all system settings for nurse call and emergency code calls; it shall manage, direct, log, and report all calls and provide analytics.
- The system shall have a separate password protected web-based interface for management and log reporting.
- Areas, services, rooms within the hospital, telephone numbers and addresses, nurses, code teams, and user information shall be updated in the management interface.
- Message sending duration, intervals, and personnel assignments for services and areas of the hospital shall be visible for every call.

- There shall be a table showing active/passive status of all system devices. Devices that are nonoperational due to problems such as power, network connection, or other issues shall be automatically detected.
- The IP System Controller may test all or selected devices identified in the system with one process. Test results shall be reported. In case of errors, error information may be notified.
- Call types, locations, timestamps, and response durations shall be reported in the reporting interface.
- If a call is not responded to within a time period configured based on call type, it shall be cancelled and recorded as a non-responded call and escalated if requested by the institution.
- All calls shall be received on a single reporting system.
- Log reports shall be constructed in a way to maintain records for minimum 10 years.

7.2.16. PERSONNEL SMART CARD

- Contactless smart cards used throughout the system shall be ISO/IEC 14443 Type A, 13.56MHz MIFARE classic (Standard- 1 KB).
- Personnel information shall be accessible from the Access Control System database when integrated.

7.2.17. BACKUP and STABILITY

- **T**he system must have a minimum 99.9% working structure.
- The System controller may be placed in two locations for hot swap functionality, and shall be structured to work without interruption.
- If the connection to the IP System Controller is interrupted for whatever reason, local Nurse Control Panels shall assume the System Controller function for their local area, and allow all rooms connected to them to continue to function without interruption.
- When the System controllers come back online, the data from the local Nurse Control Panels is synchronized to the System Controllers to prevent data loss
- If for whatever reason both the System Controllers and the Nurse Control Panels are unreachable at the same time, Room Control Units shall continue to operate under the card authorizations they last received before the connection outage, and continue service via the Over Door Lights.
- All terminals working in the system shall be monitored by the System controller for errors and the System controller shall notify defined technical service's pagers and/or Android-based smartphones of the location and description of the error in text.
- These error logs shall be able to be accessed through the Building Management System and/or Hospital Information System if such integrations are made.

7.2.18. INTEGRATION WITH IPBX SYSTEM

- The nurse call system shall be integrated with hospital IPBX system through SIP protocol. The nurse station & patient handset with speech shall have their dedicated IP so that both can be used as IP telephone. There shall be dial pad in nurse station & patient handset with speech to make call to intercom, or mobile phone/ STD etc. as permitted in the IPBX system.

7.2.19. COMPLIANCE AND STANDARDS:

- Compliance with Healthcare Regulations: Adherence to local and international standards for patient safety and system reliability.
- Certification: CE, UL, or other relevant certifications ensuring quality and safety.

7.3.KITCHEN EQUIPMENTS

1	**WORK TABLE FOR SUPPORT OF TWO BURNER RANGE**
	Size 1350x600x850mm
	Top & under shelf of S.S.sheet on MS.anlge frame work & S.S.tubular legs, with adjustable feet. Top to have sound deadning material lining as required.
2	**EXHAUST HOOD (Without Ducting, Fixing & Extraction fan) FOR TWO BURNER RANGE**
	Size 1950x750x600mm
	Made of s.steel sheet, 20G th`ick duly welded & pop riveted as required. The hood will be complete with S.S.sheet removable type baffle filters. Complete with grease collection channel & grease collection cup/s.
3	**JUICER (table top model)**
	Cast Aluminum/CI body, duly polished / painted, with worm & perforated insert. Top feeding tray. Worm easily cleanable fitted with 1/2HP elect. motor.
4	**CONVEYOR TOASTER**
	App. Cap. 100-125 Toasts/hr.
	S.S.Sheet body, having S.S.sheet conveyor belt. App.225mm wide. The unit will have heating elements on top & lower portion of conveyor belt with variable heat & speed control switch. (MADE IN ITALY)
5	**WORK TABLE**
	Size 1500X600X850mm
	Top & under shelf of S.S.sheet on M.S.anlge frame work & S.S.tubular legs, with adjustable feet. Top to have sound deadning material lining as required.
6	**FOOD TROLLEY WITH 4 ROUND PANS, 1 RICE TRAY & STORAGE beneath**
	O/S 1350X750X900mm
	S.S.Sheet insulated body, Frame work of M.S.anlge of size 38x38x5mm, mounted on 4 castors (2 with brakes) of size 150mm top to have cutout for 4nos. Round pans for Dal, Subzi etc. with 1 rice tray & storage below. Three side covered with S.S.sheet with s.

7	**TRAY CARRIER TROLLEY**
	Size 1200X600X1200mm
	S.S.Bottom base shelf mount at 150mm with all four sides turned down 50mm in 12mm and secured to welded S.S.anlge frame work & PROVIDED WITH THREE NOS. OF DETACHABLE TRAYS CUM SHELFS UNIT WILL BE MOUNTED ON 4" PILLAR TYPE CASTORS WHEELS (2 NOS. WITH BRAKE & 2 NOS. WITHOUT BRAKE)
	TRAY SET UP COUNTER WITH BAIN MARIE & DOUBLE OVERSHELVES
	Size 1800x600x850+375+225
	Top of 16G S.S.sheet, Bain Marie water tank of 18G S.S.sheet, fitted with 3.0kw heating element with automatic temperature controller. Water outlet provision with drain valve, 3 sides covered with 20G S.S.sheet, Top to accommodate S.S.sheet Food Pans with GN pan 1x2x4" depth with lid 5 sets.
8	**STORAGE CABINET**
	Size 1200X600X850mm
	Top of 16Swg S.S.Sheet one over shelf, three sides of 20SWG S.S. sheet. Dish storage cabinet with 2 shelves and sliding door will be provided on service side.
9	**STORAGE RACK**
	Size 900X450X1800
	Vertical of 32 mm dia stainless steel pipe with adjustable feet 4 no of 18 S.S Sheet at equaly distance.
10	**POT RACK-3 TIER**
	Size 1200X600X1500mm
	Verticals of 32mmX32mm square S.S.pipe, 3 shelves welded with vertical frame of 19mm dia S.S.pipe shelves with equal space between two tubes mounted on adjustable feet.

7.4.SIGNAGE & ASSOCIATED WORKS

a. Signage (Internal & External)

i. The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the Signage, till completion and handing over of the work.

ii. The item of work for the respective signage shall be conforming to Specifications and shall cover all operations, fabrications and their installations and materials required for finished product. and nothing extra shall be payable on this account.

iii. The signage work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of such fabricator for the approval of the Engineer-in-Charge.

iv. The Contractor shall submit the Design, Size and installation procedure along with samples to The Engineerfor approval. Approved samples will be kept at site till the whole work is completed. The Engineerhas right to modify the design of the approved samples and Contractor is bound to follow these written instruction/ changes in design/ size etc. from Engineer-in-Charge.

v. The typical patterns shown in the drawings. The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating signage with detailing of frame work, if any, along with the fixing details. The details of the signage including location, etc. shall be shown in the shop drawings.

vi. The Contractor shall procure and submit to the Engineer-in-Charge, samples of various materials for the signage work, for approval. After approval of samples of materials, the Contractor shall prepare sample(s) for approval of Engineer-in- Charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-in-Charge. 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.

vii. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform 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 nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

viii. The item includes the cost of all inputs of labour, materials, T & P other incidental charges, wastages etc. The items also included providing and fixing with stainless steel anchor fasteners or other suitable arrangement for fixing the signage.

ix. 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.

b. External Signage

i. The electrical power supply points, if required, for operation of the signage shall be provided by the Client.

ii. The Contractor shall submit the design for the support structure, including foundations, if required, for the approval of the The Engineer and nothing extra shall be paid to the Contractor in this account.

7.4.1. SIGNAGES AND ASSOCIATED WORKS GENERAL

1. The sign board shall be in both English and Hindi language
2. Suitable pictogram to be provided as per approved samples
3. The colour of signages to be as per discretion of Engineer.
4. All signages details including sizes of sheet, letters, pictogram and border allround to be submitted and got approved priorly
5. The quoted rate shall be for all heights and floor levels.
6. The scope of work include providing and fixing base frame with removable/interchangeable signages. Which will be paid in respective items

7.4.2. PVC SHEET / SUN BOARD

1. Sheet to be best available brand of minimum thickness 3mm.
2. Top vinyl film to be best available brands of LG, Samsung or equivalent.
3. The thickness of film without adhesive to be around 75 microns and with adhesive to be 100 microns.
4. The fixing to be done with screws / hanging chains/pipes/rods of approved make & material as per discretion of Engineer.
5. The rates to be quoted per square inch inclusive of pictogram & fixing up to any floor and height, wall fixing or hanging on ceiling.

7.4.3. MS

1. The make of material to be as approved by engineer.
2. The thickness of GI sheet should be as per approved drawing/ design .
3. The shop drawings of supporting structural frame and its foundation for signages to be submitted for approval by JDA.
4. The welding joints to be rubbed and grinded to give a smooth finish. No undulations shall be visible.
5. The MS frame and sheets to be primered and painted with approved make

material.

7.4.4. STAINLESS STEEL

1. The thickness of sheet to be as per approved drawing/ design.
2. The same to be fixed with SS screws.
3. The engraving of letters to be as per standard norms and colours.
4. The individual alphabets/ letters, wherever required to have an inbuilt arrangement for fixing to support base with stainless steel screws complete for all heights and levels. All corners to be smoothly finished & SS welding.
5. The sheet/letters may be shining or mat finish as approved by engineer.

7.4.5. ALUMINUM

The thickness of sheet to be as per approved drawing/ design.

1. Fixing to be done with SS or appropriate screws to avoid bimetallic action with aluminum.

   Samples Of All Materials, Letters Matters And Designs To Be Got Approved By Architect/ Client Before Execution Of Work.
2. The hanging aluminum hollow section to be of 100mm and 150mm width & make to be got approved. The powder coating of approved colour to be done and letters of approved specs and design to be pasted on such hanging aluminium hollow sections.
3. The hanging will be done by adjustable MS/GI rods of approved diameter and painting thereafter

Neon Glow signages

1. The diameter of tube to be got approved.
2. Make to be got approved.
3. Matter to be got approved.
4. To be made from100% handcraft glass.

Samples of all materials, letters matters and Designs to be got approved by Architect/ Client before execution of work.

7.5.HOSPITAL CUBICAL CURTAIN & TRACK SYSTEM, WALL & COLUMN GUARD

7.5.1. CURTAIN TRACKS

The System of fixing the Optitrac® Cubicle Curtain Track System" heavy Duty Aluminium cubicle track made of Aluminum alloy (6063-T5) having minimum size 35mm wide x 19mm high x 1.52mm thick, made of aluminium Extruded with white powder coating having properties like Tensile Strength 195 MPa, Shear Strength 150 MPa, Corrosion resistance properties with 50-60 micron Standard white powder coating with seven stage processes, Tracks to have drill guide on the top. Runners shall be of Wheel Type Roller and made from Nylon, Deralin with SS 304 Hook. Roof suspender, wall support, bridge clamp all shall me made from Aluminum Powder coated. Shall Provide factory bent track sections with one-foot radius.

End Cap: Provide thermoplastic end caps in a colour matching the track. End cap shall have a removable inner cap that allows carriers to be removed. Provide track aluminium splice to fit track section, with finish matching that of the track. Provide support sets, designed to receive attachment from track support. Provide brackets to mount to angle ceilings and receive attachment from track support. Unit includes durable hinge, latch and standard length. Acetal ipc ball and chain carriers with nonbinding nylon rollers accurately fit to track. Carriers to be fitted to curtain to prevent accidental curtain removal.

7.5.2. CUBICLE / PRIVACY CURTAIN :

Curtains fabric to comply with many safety protocols it must be stain retardant and has a coating of antimicrobial and fire retardancy effect, must be certified according to international standards, must be certified by Indian Govt approved laboratories. it has to contributes to the reduction of transferring bacteria, help in increasing/improvement of hygienic standards provide greater safety against infection. No need of sterilization after wash. The antibacterial component facilitates in reducing the growth of fungi, moulds and mildew that can develop in any type of an indoor environment. Effective after 100 washes and, it must be OekoTex certified

The Cubicals are 100% polyester cubical curtains. Fabric is to be opaque, water repellent, wrinkle free, shrink proof, Anti-odor, Anti-microbial, Anti-fungal with high strength 18" oval net nylon mesh on top and Fabric 7'6" (H) x 4' (W). Curtain Fabric shall be of 230GSM.

7.5.3. WALLGUARD

The system fixed to brick wall at 900mm center high from finished floor level comprising continuous aluminum rail retainer, 2 impact absorbing strips, end cap and high impact vinyl acrylic snap-on textured surface cover. The wall guard must be 152 mm wide, as specified by the client, must have 2mm thick aluminum retainer, must have 2 mm thick scratch and stain resistance rigid vinyl cover, should be coated with antifungal and antibacterial chemical.

The superior impact resistance Wall Guard (inpro) having Vinyl: Snap on cover of .080" (2mm) thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in

bacterial growth). Surface shall have a pebblette texture for scratch resistant and Continuous aluminum retainer of .080" (2mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish. Dimensions to be of 6" (152mm) height x 1" (25mm) depth. Inner snap-on vinyl impact black bumper of .080" (2mm) thickness x 3.930" (100mm) width x 21mm height which shall be extruded from chemical and stain resistant unplasticized polyvinyl] chloride (uPVC). The system shall resist an impact of 45.5 ft-lbs/inch while producing no visual blemishes upon the vinyl cover surface and no deformations in the aluminum retainers, as tested in accordance with applicable provisions of ASTM F 476-84, paragraph 18, Impact Test and shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The ipc system shall also conform to class A fire rating and ASTM D-543 for chemical and stain resistance. It shall include injection moulded End Caps with black reveal strip.

7.5.4. CORNERGUARD

The system fixed to brick wall at the corner from finished floor level. Adjustable end cap. High impact vinyl acrylic snap-on matt finished. “50mm wide x 10mm thickness x 900mm length “. The corner guard must be 50 mm * 50 mm, as specified the client in size with aluminum retainer and rigid vinyl, must have 2mm thick aluminum retainer, must have 2 mm thick scratch and stain resistance rigid vinyl cover, should be coated with antifungal and antibacterial chemical. the system shall be designed to withstand impact.

Providing and fixing series high impact surface mount IPS Corner Guard (Inpro) having Vinyl: Snap on cover of .080" (2mm) thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers No plasticizers shall be added (plasticizers may aid in bacterial growth). Surface shall have a pebblette texture for scratch resistant. Continuous aluminum retainer of .070" (1.8mm) thickness shall be fabricated from 6063-T5 aluminum, with a mill finish. Dimensions to be of 2" (51mm) x 2" (51mm), 90 degree. The rigid vinyl profile shall resist an impact of 30.2 ft-lbs/inch as per ASTM D-256-90b and shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The ipc system shall also conform to class A fire rating and ASTM D-543 for chemical and stain resistance. It includes Top caps and bottom caps which shall be made of injection moulded thermoplastics.

7.5.5. WALL HANDRAILS

Providing and fixing IPC Handrail (MAKE IN INDIA) having rigid vinyl snap-on cover(lead free) of 080" (2mm) thick, Surface shall have a pebblette texture for scratch and stain resistant rigid vinyl cover mounted on a sturdy continous aluminium retainer of .080" (2mm) thickness that shall be fabricated from 6063-T5 aluminium with a mill finsh. 4-5/16" (110mm) height x 1-5/8" (41mm) gripping diameter, extends 3-1/8" (79mm) from wall which has a oval gripping surface. The system shall resist an Impact Strength of 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics. The rigid vinyl shall not support fungal or bacterial growth in accordance with ASTM G-21 and G-22. The system shall also conform to class A fire rating and ASTM D-543 for chemical and stain resistance. It includes Moulded end returns with black reveal strip and mounting brackets.

7.5.6. PVC DADOOING

The System fixing IPC® Rigid PVC Sheet (MAKE IN INDIA) shall be manufactured from chemical and stain resistant un plasticized polyvinyl chloride (uPVC) with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth). Dimensions to be 4' x 8' (1.22m x 2.44m). 040" (1mm thick). Surface shall have a velvet texture for scratches and abrasions resistance. Class A fire rating and Impact Strength of 30.4 ft-lbs/ inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b and shall not support fungal or bacterial growth. Joints will be sealed with silicon Sealant.

7.6.BIO-MEDICAL WASTE TREATMENT FACILITY

7.6.1. BIO-MEDICAL WASTE MANAGEMENT SYSTEM

Improper handling of general waste may lead to cross-contamination with the hospital infectious waste and contaminate entire waste. If improperly handled and disposed of untreated, the bio-medical waste generated in a hospital may cause serious threat to the personnel handling the waste and also to the society.

The following are the key consideration in planning and designation of the biomedical Waste Management System.

Identification of Bio-Medicals Waste:

Bio-Medical Waste is generated primarily from the operation Theaters, ICU and Laboratories, Wards and other departments.

Bio-Medical Waste Management System:

The Bio-Medical Waste Management System process will cover the following aspects:

Bio-Medical Waste Treatment Facility

A Bio-Medical Waste Treatment Facility shall be provided with the following areas:

- Waste storage area
- Waste sorting area
- Waste Treatment area
- Treated Waste collection and disposal area
- Trolley Park area

The System is elaborated as under:

7.6.2. WASTE IDENTIFICATION

Areas Identified from Where Bio Medical Waste Generated Are identified as:

Operation theatres/Labour Rooms
Pathological labs and other
Laboratories
ICU
OPD
Wards
Causality
Diagnostic Areas
Other treatment areas and in the hospital

7.6.3. WASTE SEGREGATION AND COLLECTION

Segregation and collection of waster is the first and the most important pre-requisite in the process of waste management in order to minimize quantities of hazardous waste and preventing cross contamination wit non-hazardous waste. Different colored collection bags and containers will be provided for collection of bio-medical waste as follows:

COLOUR CODING AND TYPE OF CONTAINER FOR DISPOSAL OF BIO-MEDICAL WASTE

Colour Coding	Type of Container	Waste Category	Treatment/Disposal option
Yellow	Plastic Bag	Human Anatomical wastes, Animal wastes, Microbiology and Biotechnology waste (Infectious wastes from laboratory)	Incineration/Deep Burial
Red	Disinfected container / plastic bag	Microbiology and Biotechnology wastes, Soiled wastes and solid wastes	Autoclave/Microwave/ chemical Treatment
Blue /White Translucent	Plastic bag / Puncture proof Container	Waste Sharps and solid wastes	Autoclave/Microwave/ chemical Treatment /Destruction and Shredding
Black	Plastic bag	Discarded medicines, Cyto toxic drugs, Incineration ash and chemical waste	Disposal in secured landfills

7.6.4. WASTE COLLECTION BAGS

The yellow colored polybags provided for waste collection shall be made on non-chlorinated polythene which can be safely incinerated without having to open the bag. The bags shall be of colors as per recommendation of Ministry of Environment & Forests. Each bag can be easily tied up when it is full without touching the contaminated waste. The bags shall have bio-hazard symbol and inscription of type of waste to be collected into it.

The red, blue/white translucent poly bags used for collection of plastic and other solid waste are safe for autoclaving. The bags are specially designed to withstand high temperatures during autoclaving.

7.6.5. WASTE COLLECTION CONTAINERS

The Polybags will be placed inside the collection containers which in turn shall be placed at locations where waste is actually generated so that its segregation and collection is possible at the source itself.

The Collection containers are specially designed with following features

- Foot operated lid
- Sturdy construction
- Arrangement for holding non-chlorinated polybags
- Steel construction with epoxy power coating for durability

The collection container(s) shall be with or without caster wheels depending on the location of its placement.

The waste collection containers shall be of different colors for easy identification of waste that is to go into it.

7.6.6. WASTE TRANSPORTATION

Easily movable trolleys with large castor wheels shall be provided for collection of waste from different areas of the hospital and transporting the waste to the waste management yard. The trolleys shall have large containers with foot operated covers, mounted on the base framework. The trolleys shall be of sturdy construction and provided with castor wheels to easily move through various areas of the hospital.

Polybags shall be tied and taken out from the waste collection containers, which will be put into the transportation trolleys and then taken to the waste treatment yard for treatment and disposal. Persons handling polybags shall be provided with protective gloves.

7.6.7. WASTE TREATMENT

Waste collection trolleys shall be taken to the waste treatment building for its treatment / Shredding & Autoclaving/Incineration and thereafter the waste shall be disposed off.