



Indian Institute of Information Technology Sri City, Chittoor

NOTICE INVITING TENDER

NIT No: IIITS/NIT/MSB/2026/039, Dt. 17/03/2026

Name of the Work: Construction of Composite Structure including Civil, PEB, Plumbing, Fire Fighting, Electrical and HVAC works for the Multi-Purpose Sports Block at IIIT Sri City Campus

VOLUME II **TECHNICAL SPECIFICATIONS**

Technical Specifications for Civil Works

PREAMBLE

These technical specifications shall be read in conjunction with the various other documents forming the contract, namely Notice Inviting Tender & Instructions to Tenderers, Conditions of Contract, Special Conditions of Contract, Bill of Quantities and other related documents, together with any addendum issued thereto.

The absence of terms such as providing, supplying, laying, installing, fixing etc. in the description does not even remotely suggest that the contractor is absolved of such providing, supplying etc. unless an explicit stipulation is made in this contract. The owner shall bear no costs of materials, equipment's duties, taxes, royalties etc.

In addition to the general obligation of the Contractor during defect liability period, the Contractor shall guarantee successful performance of waterproofing treatments for a period of ten years from the certified date of completion of the work. The Engineer shall prescribe the form and the manner of executing such guarantees. The Contractor hereby conforms that there is nothing in the items/specifications (or a shortcoming therein) as will prevent such successful performance. The work shall be executed through approved specialists experienced in the respective trades.

The classification of various items of work for purpose of measurements and payments shall be as per bills of quantities (BOQ). Except where distinguished by the BOQ, the rates apply to all heights, depths, sizes, shapes and locations. They also cater for all cuts and wastes.

The specifications may have been divided in different sections/sub-head for convenience only. They do not restrict any cross-reference. The Contractor shall take in to account inter-relations between various parts of works/trades. No claim shall be entertained on the basis of compartment interpretations.

The payments for excavation shall be made assuming a vertical cut at the end of PCC under the foundations. The bidder should build the cost of such extra excavations in his bid including any shoring, strutting, etc. for stabilizing and safety of the sides of excavation.

The Contractor shall be required to submit and take approval from the Engineer-in-Charge/Consultant of shop drawings of the items of work specified in the specifications, Drawings or as directed from time to time. No extra payment shall be made for the same. Shop drawings shall be in metric units and shall be prepared in a format approved by the engineer.

The Contractor shall prepare and submit as-built drawings by way of making modifications/changes carried out with respect to the construction drawings issued prior to the construction of respective elements. These will be then incorporated by the respective Consultant/agency into their drawings for maintaining necessary records for the owner.

No walls and terraces shall be cut to make any opening after waterproofing has been done without approval of the Engineer. Cutting waterproofing when authorized by the Engineer in writing shall be done very carefully so that no other portion of the waterproofing is damaged. On completion of the work at such places, the waterproofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of waterproofing approved by the Engineer at no extra cost. No structural member shall be cut or chased without the written permission of the Engineer.

All materials intended to be used at site shall be tested prior to its use in an approved manner. A list of tests including frequency of tests on construction materials is included in the special specifications. The cost of all such tests and any other tests felt necessary by the Engineer shall be deemed to be included in the price of the respective materials quoted by the Contractor. Any defective materials brought to site shall be returned without any extra cost for the same.

Performance tests shall be carried out as the discretion of the Engineer on all/any items of work as directed by the Engineer. Should any item fail to pass the tests, the Contractor should be given the opportunity to take corrective measures and have the same retested to the satisfaction of the Engineer, he may at his sole discretion order dismantling of the whole or part of the works done and order the Contractor to reconstruct the same. The cost of all these operations and materials shall be borne by the Contractor without any extra claim.

The Contractor may make a special note of the strictness of the concrete mix to be adopted in items of maximum water-cement ratio, minimum slump, control of total chloride and sulphate contents, use of admixtures etc.

Minimum cement contents are given purely from durability point of view. Larger contents shall have to be provided if demanded by mixed design.

Provision of cement slurry to create bond between plain/reinforced concrete surface and subsequent applied finishes (floor, plaster, dado, skirting etc.) shall not be paid extra.

Mix design using smaller aggregate of 10mm down shall also be done in advance for the use in junction having congested reinforcement.

All full-fledged laboratories shall be established at the site to start construction and shall also stock all relevant codes as per the requirements of the special specifications.

The procedure of mixing the admixtures should be strictly as per the manufacturers' recommendations if not otherwise directed by the Engineer.

The batching plant for all concrete shall be used. Alternatively, use of ready-mix concrete from an approved source shall be permitted. Concrete shall be transported using concrete pumps of adequate capacity including necessary standby.

All the water tanks and other liquid retaining concrete structures shall undergo hydro- testing as per special specifications.

Special benches shall be provided at site for stacking reinforcement bars of different sizes as per the specifications.

Form work for beams of RCC areas shall be designed in such a way that the form work of the adjacent slabs can be removed without disturbing the props/ supports of the beams.

Wherever there are tension/suspended concrete members, which are suspended from upper-level structure members, the shuttering/scaffolding of such members at lower level shall have to be kept in place till upper-level supporting members gain minimum required strength. The

cost of such larger durations of keeping in place the shuttering/ scaffolding shall be deemed to be included in the price quoted for respective structural members.

In the mobilization period, the contractor shall carry out expeditiously and without delaying the following works

- Material testing and mix design of concrete as contemplated in the specifications.
- Setting up of full-fledged site laboratory as per the requirement of these specifications.
- Any other pre-requisite items required for final execution.

The specifications for non-Schedule items to be executed under this contract are given below.

Items, which are not covered under the specifications, shall be executed as per the latest CPWD specification and relevant IS codes or with specifications under the direction of Engineer in Charge.

Scope of Work

The work to be carried out under this contract shall consist of various items as per description of works contained in the bill of quantities. Any discrepancy between the details given in bill of quantities and that provided in technical specifications of the corresponding items, the provisions of the bill of the quantities shall take precedence.

The item rates quoted by the contractor shall, unless otherwise specified, also include compliance with/ supply of the following:

- General work such as setting out, clearance of site before setting out and clearance after completion
- A detailed program for the construction and completion of works (using CPM/ PERT techniques) including updating of all such activities based on decisions taken at the periodic site review meetings as directed by the engineer in charge.
- Samples of various materials proposed to be used in the work for conducting tests there on is required as per the provisions of the contract.
- Design of mixes as per relevant clauses of the specifications given proportions of ingredients, source of aggregates and binder along with accompanying trial mixes to be submitted to the Engineer-in-Charge for his approval before use on the works.
- Setting of field-testing laboratory with all required apparatus and staff for conducting day-to-day quality control tests.
- Any other item of work which is not specifically provided in the Bill of Quantities, but which is necessary for complying with the provisions of the contract.

Obligation of the contractor

- In order to ensure that the contract work is executed strictly in accordance with this Agreement and in time, the Contractor shall have the following obligations at no extra cost to the Engineer-in-Charge in addition to such other obligations and responsibilities as have been specified elsewhere in this Contract.
- Provision of adequate number of constructional Plant and machinery for mechanized system of construction, handling and transportation.
- Provision of special magazine at the site for storage of explosives, if necessary, for which required license shall be obtained from the concerned authorities.

Fulfill all the Contractor's labour regulations i.e. fair wages, display of notices regarding wages, payment of wages, labour records, attendance cards-cum-wage slips, labour welfare etc. as per standard practices and norms applicable at site.

All fossils, gold, silver, oil and other minerals, precious stones, coins, articles of value, of antiquity and structures and other remains/ things of geological or archaeological interest discovered on the site of the works shall be notified by the Contractor immediately to the Engineer-in-Charge for onward information to the concerned authorities.

The Contractor shall take all reasonable precaution to prevent his workmen or any other person from removing or damaging any such article(s) or thing(s) and protect the same till the removal as per the instructions of the Engineer-in-Charge.

Clearance of the site of all rubbish, debris, vats, tanks, materials, temporary structures, plant and machinery, scaffolding and filling of all pits, excavation and hand over the site in a tidy and cleaned condition.

Opening up of covered work if instructed by the Engineer, if such covering was done before inspection by the Engineer or without permission/approval from the Engineer-in-Charge.

General

- The works will be executed as indicated in the nomenclature of each item and technical specifications as given hereunder as made applicable to this contract.
- In the absence of any definite provision in the technical specifications contained herein, reference may be made to the latest CPWD, MOSRT&H, IRC, ICAO Specifications and IS codes, in that order. Wherever these are silent, the construction and completion of the works shall conform to sound engineering practice and in case of any dispute arising out of the interpretation of the above, the decision of the Engineer-in-Charge shall be final and binding on the Contractor.
- The abbreviations, CPWD, IRC, MOSRT& H, BIS, BS, ICAO ASTM, AASHTO shall be considered to have the following meaning:

CPWD: Central Public Works Department
IRC: Indian Road Congress
MOSRT& H: Ministry of Shipping & Transport (Road Wing) Government of India
BIS: Bureau of Indian Standards
BS: British Standard of the British Standard
ICAO: International Civil Aviation Organization
ASTM: American Standards of the American Society of Testing Materials.
AASHTO: American Association of State Highway and Transportation Officials.
- All the codes of practice, standards and specifications applicable shall be the latest edition with up-to-date correction slips etc. or as directed by the Engineer-in-Charges.

Testing

It is made clear that cost of testing, cost of material for testing, all field apparatus required for sampling and testing as per CPWD/IS codes and manpower incident to such testing will be provided along with necessary transport arrangement to-and-fro to the approved testing agency or laboratory by the Contractor during the construction phase of the work and defect liability period. The expenditure in this regard shall be borne by the Contractor and nothing extra shall be payable by the Client on this account. Field laboratory with all the required apparatus and

staff shall be established by the Contractor at site of work at his cost for carrying out field tests at stipulated frequencies.

Sampling and Testing

The Contractor or his accredited representative shall be present during sampling/testing and signify his concurrence for sampling / testing carried out by signing the test records. The Contractor shall be liable of all actions consequent to the test and their results as if he himself attended the tests. The Contractor is duly advised to be present himself for sampling and testing or in the alternative, have fully qualified duly authorized Engineer for this purpose.

Drawings & Shop Drawings

All drawings shall be read in conjunction with the relevant architectural, structural, MEP services drawings and technical specifications documents.

For finishes of all areas refer to the schedule of finishes drawing. The same shall be read in conjunction with the technical specification.

For all kind of doors, windows, fire door, glazing, aluminum works, WPC works, structural steel works, other MS & SS works (grills, railings & any other screen works, etc.), built-in cupboards, kitchen cabinets, toilet cabinets, light-weight roofing works with MS sheeting or poly carbonate/ multi-cell poly-carbonate sheeting, etc. (involving fabrication and erection works as/specs) and MEP work (electrical, HVAC, plumbing & fire fighting, etc.), the final execution shall comply / match with all necessary and relevant architectural, structural & MEP GFC drawings in terms of general arrangements (plans, elevations, sections, etc.), overall dimension, span, center line dimension, level & location etc., including clash detection and mitigation (if any), with the consent of the architect & the engineer in charge).

Before execution of all the above works the contractor shall follow the steps as mentioned below -

The contractor shall have a thorough check / inventory of the base-works at site (as/ built) with respect to all necessary and relevant architectural and structural GFS's. Any discrepancy between architectural & structural GFC's and base-work conditions at site shall be brought to architect's notice before initiation of the execution works.

The agency shall submit necessary shop drawings for all these works based on relevant architectural, structural GFC drawings and as/built site condition. The contractor may also be asked to provide necessary true-scale mock-up at site as per the direction of the architect & the engineer-in-charge. There after execution shall be done as per approved shop drawings.

For all aluminium works, WPC works etc., wherever there is structural support system embedded within or exposed, the shop drawings submitted by the contractor shall be duly vetted (structural) by any vetting authority approved by the owner. For these works the complete system / assembly shall be duly tested in any authorized lab for their structural stability & a site mockup shall be put up for approval of the architect & engineer in charge prior to execution at site.

For all form finished RCC works the contractor must submit shop drawings showing RCC surface elevations with panel sizes, grooves, tie-bolt positions and all MEP provisions based on relevant GFC drawings. Execution shall be done only as per the approved shop drawings.

For all finishing works, especially - flooring, wall finishes (including form finished RCC), the contractor shall submit the necessary sample board and prepare necessary site mock-up as per the direction of the architect & the engineer in charge. Execution shall be done only as per approved sample and mock-up.

For all fittings and fixtures, especially - hardware (for doors, windows, glazing, aluminium works, fire doors, all cupboards & cabinets), plumbing and sanitary cp fittings & fixtures, lighting, etc. The contractor shall submit necessary sample boards and prepare necessary site mock-up as per the direction of the architect and engineer in charge. For the external windows & openings, the contractor must explain dust-free & water-proofing arrangements in the shop drawings. Execution shall be done as per the approved sample and mock-up.

All loose furniture as shown in the layout drawings (except classrooms & auditorium inside the academic block) is indicative and not part of this tender unless mentioned specifically in the specification. These are shown only as a reference for civil finishing and MEP work.

Any work carried out by the contractor using a superseded drawing after the issue of a new revision is liable for rejection and reinstatement as per the new revision at the contractor's risk and cost without any entitlement to extension of time.

SOIL INVESTIGATION REPORT FOR PROPOSED MULTIPURPOSE SPORTS BLOCK IS ENCLOSED.

General list of codes, standards and specifications adopted in the tender documents

The following IS codes have generally been adopted in the tender documents. This list however does not limit the use of any other relevant code or standards by the Engineer-in-Charge solely at his discretion either referred to in the tender documents or not, to achieve the desired quality of work. All the codes practice, standards and specifications applicable shall be the latest edition with all correction slips, etc. or as directed by the Engineer-in-Charge.

Sl.	Indian Standard	Subject
1	Carriage of materials	
	4082-1977	Recommendations on stacking & storage of construction materials at site.
2	Earth Work:	
	1200 (Pt. I) - 1992 4081-1986	Method of measurement of Earth work safety code for Blasting and related drilling Operations.
	6313 (Pt. II) - 1981	Anti-termite measures in buildings (Part II - Pre-constructional chemical treatment).
3	Mortar:	
	196-1966	Atmospheric conditions for testing
	269-1989	Ordinary, rapid hardening and low heat Portland cement
	383-1970	Coarse and fine aggregates from natural sources for Concrete
	455-1989	Portland blast furnace slag cement
	650-1991	Standard sand for testing of cement

Sl.	Indian Standard	Subject
	712-1984	Building Lines
	1489-1991	Portland Pozzolana cement
	1514-1990	Methods of sampling & Test for quick lime and Hydrated lime
	1542-1992	Sand for plastering
	1727-1967	Methods of tests for Pozzolanic materials
	2250-1981	Code of practice for preparation and use of masonry Mortar
	2386 Pt. I-1977	Particle size and shape
	2386 Pt. II-1977	Estimation of deleterious materials and organic impurities
	2386 Pt. III-1977	Specific gravity, density, voids, absorption and bulking
	2686-1977	Cinder as fine aggregate for use of lime concrete
	3025-1987	Methods of sampling and test (physical and chemical) water used in industry
	3068-1986	Broken brick (burnt clay) coarse aggregate for use in lime concrete (II-R)
	3182-1986	Broken brick(burnt clay) fine aggregate for use in lime mortar
	3812-1981	Fly ash
	3812 Pt.I	Fly ash for use as Pozzolana
	3812 Pt.II	Fly ash for use as admixture for concrete
	3812 Pt. III	Fly ash for use as fine aggregate for mortar and concrete
	4031-1988	Methods of physical tests for hydraulic cement
	4032-1985	Method of chemical analysis of hydraulic cement
	4098-1983	Lime Pozzolana mixture
	6932 (Pt.I to X)	Methods of test for building lime
	6932 (Pt.I)-1973	Determination of insoluble residue, loss of ignition, insoluble matter, silicon-dioxide, ferric and aluminum oxide, calcium oxide and magnesium oxide.
	6932 (Pt.II)-1973	Determination of carbon dioxide content
	6932 (Pt.III)-1973	Determination of residue on slaking of quick lime
	6932 (Pt.IV) -1973	Determination of fineness of hydrated lime
	6932 (PtV)-1973	Determination of unhydrated oxide
	6932(Pt.VI)-1973	Determination of volume yield of quick lime
	6932 (PtVII)-1973	Determination of compressive and transverse strength
	6932(Pt.VIII)-1973	Determination of workability
	6932 (Pt.IX)-1973	Determination of soundness
	6932(Pt.X)-1973	Determination of popping and pitting of hydrated lime
4	Concrete Work:	

Sl.	Indian Standard	Subject
	383-1970	Coarse and fine aggregates from natural sources for Concrete
	456-2000	Code of practice for plain and reinforced concrete
	515-1959	Specifications for natural and manufactured aggregate for use in mass concrete
	516-1959	Method of test for strength of concrete
	1198-1959	Method of sampling and analysis of concrete
	1200(pt.II)-1974	Methods of measurements of cement concrete work
	1322-1982	Bitumen felts for water proofing and damp proofing
	1661-1987(pt.III)	Code of practice for application of cement lime plaster finishes
	2386-1977	Methods of test for aggregate for concrete
	2386(pt.I)-1977	Test for particle size and shape
	2386(pt.II)-1977	Test for estimation of deleterious materials and organic impurities.
	2386(pt.III)-1977	Test for specific gravity, density, voids, absorption and bulking
	238686(pt.IV)-1977	Mechanical properties
	2645-1975	Specification for integral water proofing compounds
	2686-1977	Specification for cinder aggregate for use in lime concrete
	3812-1981	Fly ash
	3812(pt.I)	Fly ash for use as pozzolana for concrete
	3812(pt.II)	Fly ash for use as admixture for concrete
	3812(pt.III)	Fly ash for use as fine aggregate for mortar and concrete
	7861-1975(pt.I)	Hot weather concreting
	7861-1981(pt.II)	Cold weather concreting
	9103-1979	Admixture for concrete
5	RCC Work:	
	432-1982	Mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
	432(pt.I)-1982	Mild steel and medium tensile steel bars
	456-1978	Code of practice for plain and reinforced concrete
	457-1957	Code of practice for general construction of plain and reinforced concrete for dams and other massive structure
	516-1959	Methods of test for strength of concrete
	1139-1966	Hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement
	1199-1959	Methods of sampling and analysis of concrete

Sl.	Indian Standard	Subject
	1200(pt.II)-1974	Methods of measurement of cement concrete work
	1200(pt.V)-1982	Method of measurement of form work
	1343-1980	Code of practice for prestressed concrete
	1566-1985	Hard drawn steel wire fabric for concrete reinforcements
	1780-1961	Specifications for cold twisted steel bars for concrete Reinforcement
	1785-1983	Specifications for plain hard draw steel wire for pre-stressed concrete
	1786-1985	Cold twisted steel bars for concrete reinforcement
	2080-1980	Specifications for high tensile steel bars used in pre-stressed Concrete
	2204-1962	Code of practice for construction of reinforced concrete shell roof. V- Page 6 of 197
	2210-1962	Criteria for the design of steel structure and folded plates.
	2502-1963	Code of practice for bending and fixing of bars for concrete Reinforcement
	2751-1979	Code of practice for welding of mild steel bars used for reinforced concrete construction
	2911-1979	Code of practice for design and construction of pile Foundations
	2911(pt.I)-1979	Load bearing concrete piles
	2911(pt.III)-1980	Under reamed pile foundations
	3201-1988	Criteria for design and construction of precise concrete trusses
	3370(part I to IV)-1965	Code of practice for concrete structures for storage of liquids
	3385-1986	Code of practice for measurement for Civil Engineering works.
	3414-1968	Code of practice for design and installation of joints in Buildings
	3588-1987	Code of practice for use of immersion vibrators for consolidating concrete
	3935-1966	Code of practice for composite construction
	4014-1967(pt.I & II)	Code of practice for steel tubular scaffolding (I: Definition / Material: II: Safety Regulations)
	4990-1981	Specifications for plywood for concrete shuttering work
	10262	Code of practice for design mix
6	Equipment:	
	460-1985	Specification for test sieves
	1791-1985	Specification for batch type concrete mixer
	2430-1986	Specification for roller pan mixer

Sl.	Indian Standard	Subject
	2585-1968	Specification for concrete vibrators, immersion type
	2806-1964	Specification for screen board concrete vibrators
	2514-1963	Specification for concrete vibrating tables
	3366-1965	Specification for pan vibrators
	4656-1968	Specification for form vibrators for concrete
	2722-1964	Specification for portable swing weight batchers for concrete (single and double bucket type)
	2750-1964	Specification for steel scaffolding
7	Brick Work:	
	1077-1986	Common burnt clay building bricks
	1200(pt.III)-1976	Method of measurements of brick work
	2116-1980	Sand for masonry mortars
	2212-1962	Code of practice for brick work
	2250-1981	Code of practice for preparation & use of masonry Mortar
	3102-1971	Classification of burnt clay solid bricks
	3495(pt.I to IV)-1976	Method of test for clay building work
	IS 2572-2005	Construction of hollow and Solid Concrete Block Masonry
	5454-1978	Method for sampling for sampling of clay building bricks
8	Stone Work:	
	1121-(pt.I)-1974	Methods for determination of compressive, transverse and shear strengths of natural building stones
	1122-1974	Methods for determination of specific gravity and porosity of natural building stones
	1123-1975	Methods of test for water absorption of natural building stones
	1124-1974	Methods of test for absorption of natural building stones
	1125-1974	Methods of test for weathering of natural building stones
	1126-1974	Methods of test for durability of natural building stones.
	1129-1972	Dressing of natural building stones
	1200(pt.IV)-1976	Method of measurement of stone masonry.
	1597-1967	Code of practice for construction of rubble stone masonry
	1597(pt.I)-1992	Code of practice for construction of masonry
	1597(pt.II)-1992	Code of practice for construction of Ashlar masonry
	1805-1973	Glossary of items relating to stone quarrying and Dressing
	4101(pt.I)-1967	Stone facing
9	Marble Work:	
	1122-1974	Methods for determination of specific gravity and

Sl.	Indian Standard	Subject
		porosity of natural building stones
	1124-1974	Methods of test for water absorption of natural building stones
	1130-1969	Marble (blocks, slabs and tiles)
10	Wood Work:	
	204-1991/92	Tower bolts (Part 1-1991:ferrous metals : part –II-1992: non-ferrous metals)
	205-1992	Non-ferrous metal butt hinges
	206-1992	Tee and strap hinges
	207-1964	Gate and shutter hooks and eyes
	208-1987	Door handles
	281-1991	Mild steel sliding door bolts for use with padlocks
	287-1973	Recommendation for maximum permissible moisture contents of timer used for different purposes.
	303-1989	Plywood for general purpose
	362-1991	Parliament hinges
	363-1993	Hasps and staples
	364-1993	Fanlight catch
	401-1982	Code of practice for preservation of timber
	451-1973	Technical supply condition for wood screws
	452-1973	Door springs, rail-tail type
	453-1993	Double acting spring hinges
	723-1972	Steel counter sunk head wire nails
	729-1979	Drawer locks, cup-board locks and box locks
	848-1974	Synthetic resin adhesive for plywood (phenolic and amino plastic)
	851-1978	Synthetic resin adhesive for construction work
	852-1994	Specifications for animal glue for general wood working Purposes
	1003	Timer paneled and glazed shutters
	1003(pt.I)-1991	Door shutters
	1003(pt.-II)-1994	Window and ventilator shutters
	1019-1974	Rim latches
	1141-1993	Code of practice for seasoning of timer
	1200	Method of measurement and Building of Civil Engineering Works
	1200(pt.XIV)-1984	Glazing
	1200(pt.XXI)-1973	Wood work and joinery

Sl.	Indian Standard	Subject
	1322-1993	Bitumen felts for water proofing and damp proofing
	1328-1982	Veneered decorative plywood
	1341-1992	Steel Butt hinges
	1378-1987	Oxidized copper finished
	1568-1970	Wire cloth for general purposes
	1629-1960	Rules for grading of out size of timer
	1658-1977	Fiber hard board
	1659-1990	Block boards
	1823-1980	Floor door stoppers
	1868-1982	Anodic coating on Aluminum
	1911-1967	Schedule of unit weights of building materials
	2191-1983	Wooden flush door shutter (cellular and hollow core type)
	2191(pt.I)-1983	Plywood face panels
	2191(pt.II)-1983	Particle board face panels for wooden flush door shutters
	2202	Wooden flush door shutters (solid core type)
	2202(pt.I)-1991	Plywood face panels for wooden flush door shutters
	2202(pt.II)-1983	Particle board face panels for wooden flush door shutters
	2209-1976	Mortise locks (vertical type)
	2380-1981	Method of test for wood particle board and boards from lignocelluloses materials
	2681-1993	Non-ferrous metal sliding door bolts for use with pad locks
	2835-1987	Flat transparent sheet glass (3rd revision)
	3087-1985	Wood particle boards (medium density) for general purpose
	3097-1980	Veneered particle boards (1st Revision)
	3400	Method of test for vulcanized rubbers
	3400(pt.II)-1980	Hardness
	3400(pt.IV)-1987	Accelerated aging
	3400(pt.IX)-1978	Relative density and density
	3564-1986	Door closers (hydraulically regulated)
	3618-1966	Phosphate treatment of iron and steel of protection against corrosion
	3813-1987	“C” hooks for use with swivels
	3818-1992	Continuous (piano) hinges
	3847-1992	Mortise night latches
	4020-1967	Methods of tests for wooden flush doors (type tests)
	4021-1983	Timber door, windows and ventilator frames

Sl.	Indian Standard	Subject
	4827-1983	Electroplated coating of nickel and chromium on copper and copper alloys.
	4948-1974	Welded steel wire fabric for general use
	4992-1975	Door handles for mortise locks (vertical type)
	5187-1972	Flush bolts
	5523-1983	Method of testing anodic coating on aluminum and its alloys
	5930-1970	Mortise latch (vertical types)
	6318-1971	Plastic window stays and fasteners
	6607-1972	Rebated mortise locks (vertical type)
	6760-1972	Slotted countersunk head wood screws
	7196-1974	Hold fasts
	7197-1974	Double action floor springs (without oil check for heavy doors)
	7534-1985	Mild steel bolts with holders for padlocks
11	Steel Work:	
	63-1978	Whiting for paints
	198-1978	Varnish, gold size
	226-1975	Structural steel (standard quality)
	277-1985	Specification for galvanized steel sheets (plain and corrugated)
	278-1978	Galvanized steel barbed wire for fencing
	800-1984	Code of practice for use of structural steel in General building construction.
	806-1968	Code of practice for use of steel tube in general building construction
	813-1986	Scheme of symbols for welding
	814-1991	Covered electrodes for metal are welding of structural steel.
	814(pt.I)-1974	For welding products other than sheets
	814(pt.II)-1974	For welding sheets
	815-1974	Classification and coding of covered electrodes for metal are welding of mild steel and low alloy high tensile steel.
	817-1966	Code of practice for training and testing of metal are welders
	818-1968	Code of practice for safety and healthy requirements in electric and gas welding and cutting operation.
	1038-1983	Steel doors, windows and ventilators
	1081-1960	Code of practice for fixing and glazing of metal (steel and aluminum) door, windows and ventilators)
	1148-1982	Hot rolled steel river bars (up to 40mm diameters) for structural purposes

Sl.	Indian Standard	Subject
	1161-1979	Steel tubes for structural purposes
	1182-1983	Recommended practice for radiographic examination of fusion welded joints in steel plates
	1200-1974	Method of measurements of steel work and iron works
	1363-1984	Hexagon bolts, nuts and lock nuts (dia 6 to 39mm) and black hexagon screws (dia 6 to 24 mm)
	1599-1985	Method for bend test for steel products other than sheet, strip, wire and tube
	1608-1972	Method for tensile testing of steel products
	1821-1987	Dimensions for clearance holes for metric bolts
	1852-1985	Rolling and cutting tolerance for hot rolled steel products
	1894-1972	Method for tensile testing of steel tubes
	1977-1975	Structural steel (ordinary quality)
	2062-1984	Structural steel (fusion welding quality)
	4351-1976	Steel door frames
	4736-1986	Hot-dip zinc coatings on steel tubes
	6248-1979	Metal rolling shutters and rolling grills
	7452-1990	Hot rolled steel sections for doors, windows & ventilators
12	Flooring Work:	
	210-1978	Grey iron casting
	653-1992	Sheet linoleum
	777-1988	Glazed earthen-ware tiles
	809-1992	Rubber flooring materials for general purpose
	1122-1974	Methods for determination of specific gravity and porosity of natural building stones
	1124-1974	Method of test for water absorption of natural building stones
	1130-1969	Marble (blocks, slabs and tiles)
	1197-1970	Code of practice for laying of rubber floors
	1198-1982	Code of practice for laying and maintenance of linoleum floors
	1200(pt.XI)-1977	Method of measurements of paving and floor finished
	1237-1980	Cement concrete flooring tiles
	1443-1972	Code of practice for laying and finishing of Cement concrete flooring tiles
	1661-1972	Code of practice for application of cement and cement lime plaster finishes
	2078-1979	Method of tensile testing of gray cast iron
	2114-1984	Code of practice for laying in situ terrazzo floor finish

Sl.	Indian Standard	Subject
	2571-1970	Code of practice for laying in situ cement concrete flooring
	3400	Method of test of vulcanized rubbers
	3400(pt.II)-1980	Hardness
	3400(pt.X)-1977	Compression set at constant strain
	3462-1986	Flexible PVC flooring
	8318-1969	Code of practice for laying of flexible PVC sheet & tiles flooring
	5389-1969	Code of practice for laying hardwood parquet and wood block floors
13	Roofing Works:	
	73-1992	Paving Bitumen
	277-1992	Galvanized Steel sheets (plain and corrugated)
	458-1988	Concrete pipes (with and without reinforcement)
	459-1992	Un reinforced corrugated and semi corrugated
	651-1992	Asbestos cement sheets
	702-1988	Salt glazed stone ware pipes and fittings
	1199-1959	Industrial Bitumen
	1200(pt.IX)-1973	Method of sampling & analysis of concrete
	1200(pt.X)-1973	Method of measurements of roof covering (including cladding)
	1202-1978	Method of measurements of ceiling and lining
	1203-1978	Determination of specific gravity for testing Tar and Bitumen
	1205-1978	Determination of penetration for testing Tar and Bitumen
	1208-1978	Determination of Ductility for testing Tar and Bitumen
	1209-1978	Determination of flash point and fire point for Testing tar and bitumen
	1211-1978	Determination of water content for testing Tar and bitumen
	1212-1978	Determination of loss on heating for testing Tar and bitumen
	1216-1978	Determination of solubility in carbon disulphide for testing Tar and bitumen
	1322-1993	Bitumen felts for water proofing and damp proofing
	1346-1976	Code of practice for waterproofing of roof with Bitumen felts
	1609-1991	Code of proactive for laying damp proof treatment using bitumen felts
	1626-1994	Asbestos cement building pipes, gutters and fittings (spigot and socket types)
	1834-1984	Specification for hot applied sealing compounds for joints in concrete

Sl.	Indian Standard	Subject
	1838-(pt.I)-1983	Preformed filler for expansion joints in concrete non-extruding and resilient type (bitumen impregnated fiber)
	2115-1980	Code of practice for flat roof finish mud phuska
	2633-1986	Method of testing uniformity of coating on zinc coated articles
	3007-(pt.I)-1964	Code of practice for laying of corrugated asbestos cement sheet
	3348-1965	Fiber insulation boards
	3607-1979	Magnetite for chemical industry
	7193-1994	Specifications for glass fiber base coal tar pitch & Bitumen felts
	8183-1993	Bonded mineral wool
14	Finishing Work:	
	75-1973	Linseed oil, raw and refinery
	77-1976	Linseed oil, boiled, for paints
	102-1962	Ready mixed paint, brushing, red, lead for priming and general purposes
	103-1962	Ready mixed paint, brushing, white lead for priming and general purposes
	104-1979	Specification for ready mixed paint, brushing, Zinc chrome priming
	133-1993	Enamel, interior (a) under coating (b) finished colour as required
	137-1965	Ready mixed paint, brushing, matt or egg-shell flat, finishing, interior, to Indian Standard colour, as required
	158-1981	Ready mixed paint, brushing, bituminous, black lead free acid alkali, water and heat resting for general purposes
	168-1993	Read mixed paint, air drying for general purpose
	217-1988	Cut back bitumen
	218-1983	Creosole and anthracene oil for use as wood preservatives
	290-1961	Coal tar black paint
	337-1975	Varnish, finishing interior
	338-1952	Varnish, under coating exterior, natural resin
	339-1952	Varnish under coating, exterior, synthetic resin
	340-1978	Varnish mixing
	341-1973	Black Japan, type A, B and C.
	345-1952	Wood filler, Transparent, liquid
	347-1975	Varnish shellac for general purpose
	348-1968	French polish
	419-1967	Putty for use of window frames

Sl.	Indian Standard	Subject
	427-1965	Distemper, dry, colour as required
	428-1969	Distemper., oil emulation, colour as required
	524-1983	Varnish, finishing exterior, synthetic
	525-1968	Varnish, finishing exterior and general purposes
	533-1973	Gum spirit of turpentine (oil of turpentine)
	712-1984	Specification for building limes
	1200(pt.XII)-1976	Method of measurements of plastering and pointing
	1200(pt.XIII)-1987	Method of measurements of white washing
	1200(pt.XV)-1987	Method of measurements of painting, polishing & varnishing
	2095-1982	Gypsum plaster boards
	2096-1992	Asbestos cement flat sheets
	2339-1963	Aluminum paint for general purposes, in dual container
	2547-1976	Gypsum building plaster
	2932-1994	Enamel synthetic, exterior (a) Under coating (b) Finishing
	2933-1975	Enamel, Exterior (a) Under coating (b) Finishing
	5410-1992	Cement paint, colour as required
	5411(pt.I)-1974	Plastic emulsion paint for interior use
	6278-1971	Code of practice for white washing & colour washing
15	Demolition & Dismantling:	
	1200(pt.XVIII)-1974	Method of measurements of demolition and dismantling
16	Safety Codes:	
	818-1968	Safety and healthy requirements in Electric and gas welding and cutting operations
	3698-(pt.I)-1987	Safety code for scaffolds
	3696(pt.II)-1966	Safety code for ladders
	3764-1966	Safety code for Excavation works
	4081-1986	Safety code for blasting and related drilling operation
	4130-1976	Safety code for demolition of building
	5916-1970	Safety code for construction involving use of hot bituminous materials
	6922-1973	Structure subject to underground blasts code of practice for safety and design for
	7293-1974	Working with construction machinery safety code

LIST OF APPROVED MAKES (CIVIL & INTERIOR WORKS)		
Sl.	MATERIAL	APPROVED MAKES
	Civil Works	
1	Anti-Termite Chemical	NOCIL/ Bayer/ Hindustan insecticides/ ISS Hicare/ Bharat Certis Agri Science Ltd./ Dharmaj Crop Gurad Ltd./ Jai Shree Ram Agro
2	Cement	ACC/ Birla / Ultratech / JK / Ambuja / Shree
3	TMT Steel	TATA TISCO / SAIL / JSW Steel / Vizag Steel
4	Bitumen Impregnated Expansion Board	Bengal Chemical Ltd./ STP
5	Construction Chemicals & Plasticisers	Fosroc / Roff / Pidilite / Sika
6	Bitumen	Aggarwal/ Tiki Tar/ Bitumen India/ Bitcol
7	Non Shink Grout	Fosroc / Sika / BASF / Soprema/ Pidilite
8	Water Proofing Chemicals & Membranes	Fosroc/ Sika/ BASF/ Soprema/ Pidilite/ Ardex Endura
9	Geotextile fabric	Manas/ Suntek/ Ocean/ Parishudh/ Parry/ J.T. Fabric
10	UPVC Pipes	Astral/ Supreme/ Finolex
11	Autoclaved aerated concrete Block	Magicrete/ Prime ACC/ Biltech
12	Welded Mesh	Swish Weldmesh / IRC/ Multiweld Wire Co.
13	RMC (Ready mixed Concrete)	Ultratech/ Prism/ RDC or approved equivalent
14	Shuttering Material	Mivan/ Peri/ Doka or approved equivalent
	Wall Finishing Work	
13	White Cement Based Putty	Birla/ JK/ British paint
14	Non pigmented Textured Paints	Ultratech/ Asian/ Berger/ SKK
15	Internal Texture Paint (wall & ceiling)	Oikos/ Asian/ Ultratech
16	Cement based Paint	Snowcem / ICI/ Berger
17	Acrylic Smooth exterior paint	Asian / Nerolac / Berger/ Dulux/ ICI
18	Acrylic interior paint	Asian / Nerolac / Berger/ Dulux/ ICI
19	Dry Distemper /OBD	Asian / Nerolac / Berger / Dulux / ICI
20	Ceramic glazed wall tiles	Nitco / Kajaria / Johnson / RAK / Somany/ Orient
21	Acoustical Insulation	UP Twiga / Lloyd Insulation
22	Lacquered Glass	Saint Gobain Planique/ AIS /Modi
23	Anti-Fungal Paints	Asian / Dulux / ICI / Berger
24	Glass partitions & Doors profiles	Dorma/ Jeb/ Alloy
25	Frosting Film	3M/ Llummar/ LG
26	Epoxy Paint	Asian/ Sika/ Neo
27	Plywood, Block Boards, Particle Boards	Green/ Century/ Archid/ Kitply/ Duro
28	Upholstery Foam	Sheela/ Allied/ Flexipol/ SKPI/ Jumex/ Suryaa
29	Calcium silicate board, tiles & panel	Ramco/ Aerolite/ Armstrong
30	MDF Board	Greenpanel/ Century/ Actiontesa
31	Mirror	Modiguard / Saint Gobain/ AIS
32	Plaster of Paris	Sakarni/ Shriram/ Superfine/ JK
33	Changing room lockers	Godrej / Greenlam / equivalent
34	PVC seating for halls	Innovative Seatings / KF systems /equivalent
35	Storage Rack	Godrej/ Silverlining/ Giraffe/ Spider/ Mex

LIST OF APPROVED MAKES (CIVIL & INTERIOR WORKS)		
Sl.	MATERIAL	APPROVED MAKES
	Steel Work & Roofing	
36	Structural Steel Section	Tisco/ SAIL/ Apollo/ Vizag/ JSW
37	Structural Steel tubular Section	Tata Structura/ Apollo Steel Pipes/ SAIL/ Kalinga/ JSW
38	Welding Rods	Advani/ Esab/ Nucor
39	Mild Steel Plates, Flat, Angles, Chequered Plate	Tisco/ SAIL/ Apollo/ Vizag/ JSW
40	Stainless Steel	Salem/ Jindal
41	Synthetic Enamel Paint	Asian / Nerolac / Berger / Dulux / ICI
42	Deck sheeting	Tata/ SAIL/ Lloyd/ Jindal/ Essar/ JBP
43	Fire rated Paint	Akzo Nobel Coatings Pvt. Ltd./ Asian Paints Ltd.
44	Roof Sheetting	Tata Bluescope/ Multicolor/ Jindal
45	Multiwall/ Plain Polycarbonate	Danpal/ DPI Daylight / Polygal / Coxiwell
	Flooring Works	
46	Vitrified Tiles	Nitco / Kajaria / Johnson / RAK / Somany / Restile
47	Tactile tile	Johnson / Somany / Restile
48	Tile Adhesive	Laticrete / Ardex Endura / Weber
49	Epoxy Filler Grout	Laticrete / Ardex Endura / Weber / Fosroc/ Sika
50	Floor Surface Hardeners	Fosroc/ BASF /Sika
51	Glass Fiber reinforcement	Recron/ UP Twiga/ Owenscorning
52	Acrylic emulsion cement modified and water based concrete bonding agent	Sika/ Fosroc/ Pidilite/ Soprema
53	Epoxy urethane joint Sealer	Fosroc/ Sika/ Laticrete / Ardex Endura / Weber
54	Road marking Paint	Asian PPG/ ITS coating/ Kataline
55	Self Levelling screed	Fosroc/ Dubond/ Neocrete
56	Bamboo plank Flooring & Cladding work	Epitome / equivalent
57	Heavy Duty Door Mats made with flexible vinyl (Virgin PVC)	3M or equivalent
	Ceiling Works	
1	Gypsum board/Tiles ceiling	Saint Gobain Gyproc/ Lafarge Boral Gypsum/ Knauf
2	Calcium silicate board/ Tiles Ceiling	Ramco/ Aerolite/ Approved equivalent
3	Mineral fibre tiles Ceiling	Armstrong/ Saint Gobain/ USG Knauf/ Anutone
4	Open cell ceiling	Durlum/ Lindner /Hunter Douglas/ Armstornng
5	Acoustical Glass wool ceiling	Ecophone/ Armstrong/ USG Knauf/
6	Acoustical Baffle	Ecophone/ USG/ Knauf/ Armstrong
7	Acoustical Spray Plaster	Ecophone/ Asona/ Approved equivalent
	Door, Windows & Coverings	
8	Flush Doors	Duro/ Century/ Green/ Merino/ Mayur/ Kitply
9	Laminates	Greenlam / Merino/ Formica/ Century
10	Veneer	Decowood Green/ Duro/ Century

LIST OF APPROVED MAKES (CIVIL & INTERIOR WORKS)		
Sl.	MATERIAL	APPROVED MAKES
11	Stainless Steel hardware	Ozone/ Geze/ Dorma/ haffele/ Hettich
12	Fire rated Door hardware	Hormann/ Geze/ Dorma/ Assa Abloy
13	Aluminium Extrusion	Jindal/ Hindalco/ SAPA/ Bourka/ Century/ Global/
14	Aluminium Hardware	Alualpha/ Lavaal/ Giesse/ Kinlong
15	Aluminium Louvers	Technal/ Fasado/ Vitrocsa/ Sapa/ VS1/ Wicona
16	Microwave Cured EPDM Gasket	Avigiri/ Kotwan/ Osaka
17	Aluminium Skirting, Corner, Groove, covering, transit profiles	Alucraft/ Baux/ Dural trims
18	Fire Rated Steel Door	Shaktihormann/ Navair/ Sukri/
19	General Steel Door	Shaktihormann/ Navair/ Sukri/
20	Acoustical Steel Door	Shaktihormann/ Navair/ Sukri/
21	Fire rated Glazed Door	Shaktihormann/ Navair/ Sukri/
22	Toilet Partitions/ Cubicles	Greenlam/ Merino
23	Window Blinds	Hunter Douglas/ Vista/ De Décor/ MAC
24	Wood Adhesive	Fevicol / Jivanjor / Vamicol
	Façade Work	
25	Aluminium Extrusions	Jindal / Bhorka / Sapa /Hindalco
26	Reflective Glass	Saint Gobain /Guardian / Sisecam/ Asahi
27	Clear Float Glass	Saint Gobain /Guardian / Sisecam/ Asahi
28	Fire Rated Glass	Saint Gobain / Pilkington / Schott
29	Glass Processing	Saint Gobain / GlassTech / Sejal / FG / Fuso / Asahi / Impact Safety
30	PVB Lamination	Kuraray
31	SGP Lamination	Kuraray
32	Weather Sealant	Sika / DowCorning / Momentive
33	Structural Sealant	Sika / DowCorning / Momentive
34	ACP	Alpollic / Alucobond / Reynobond / Alstone / Virgo
35	Solid Aluminium Sheet	Novelis / DWALL Metallic
36	Anchor Fastners	Hilti / Fischer / Mungo
37	Anchor Channels (Cast in Channel)	Halfen / Hilti / Jordhal
38	EPDM & Silicon Gasket	Amee Rubber / Osaka / Eltech
39	Powder Coating	Jotun / Akzonoble
40	PVDF Coating	Valspar / PPG / Akzonoble
41	Powder & PVDF Processer	SP Coating / MJ Coaters / Aura International
42	Spacer Tape (Open PU Cell)	Norton / BOW
44	Glass wool (Insulation)	UP Twiga / Rockwool
45	Rock wool (Fire Stop)	Siderise / Hilti
46	Smoke Seal Intumescent	Siderise / Hilti
47	Baker Rod	Supreme Industries
48	SS Spider Fittings	Dorma / Kin Long
49	SS Patch Fitting	Dorma / Kin long/ Kaba

LIST OF APPROVED MAKES (CIVIL & INTERIOR WORKS)		
Sl.	MATERIAL	APPROVED MAKES
50	Automatic Sliding doors	Dorma / Geze / Kaba
51	Revolving Doors	Dorma / Boonedam / Kaba
52	SS Clamps (Stone cladding)	Hilti / Blick
53	Mild steel	Jindal / Sail / Tata
54	Stainless Steel	Salem Steel
55	Façade Systems	Technal / Schueco / Aluk/ Fasado
56	Anodizing	Dow Chemicals
57	Accessories	
57.01	SS Friction Hinges	Giesse / Cotswold / Securistyle / system based
57.02	Multipoint Locking sets	Giesse / Cotswold / Securistyle / system based
57.03	Handle	Giesse / Cotswold / Securistyle / system based
57.04	Rollers for Slidings	Giesse / Alualpha / Savio / Alutech / Lavaal
57.05	Flush lock for Slidings	Giesse / Alualpha / Savio / Alutech / Lavaal
58	Stainless Steel Cramps	Hilti / Fischer/ Canon
59	GRC Jali	Unistone/ Birla/ Everest/ Shenisha
60	Alumnium Expanded Metal Jali System	Citadel/ PEMPL /
61	Aluminium Louvered System	Hunter Douglas/ Durlum/ Lindner
62	Aluminium composite panel	Alucobond/ Eurobond/ Aludecor/ Reynobond/ Alstone/ Alstrong
63	UPVC Window	Fenesta/ Saint Gobain/ AIS window
	Road Work	
64	Bitumen	Aggarwal/ Tiki Tar/ Bitumen India/ Bitcol
65	Interlocking concrete Paver Block	As per approved sample
	Lifts (Elevators)	
66	Passenger Lift	Otis/ Kone/ Schindler/ Johnson/ Mitsubishi
67	Good Lift	Johnson/ TKE/ Otis

TECHNICAL SPECIFICATIONS FOR SPECIALIZED WORKS

1. Technical Specification for Pre-Constructional Anti-Termite Treatment

1.1 Scope of Work

The work involves providing and injecting a chemical emulsion to create a continuous chemical barrier for pre-constructional anti-termite treatment. This includes treatment under and around column pits, walls, trenches, basement excavation, top surface of the plinth filling, junction of wall and floor, along the external perimeter of the building, expansion joints, over the top surface of consolidated earth on which the apron is to be laid, and surrounding pipes and conduits.

1.2 Materials

- **Chemical:** Chlorpyrifos 20% E.C. or Lindane 20% E.C.
- **Concentration:** The chemical should be diluted in water to achieve a 1% concentration.
- **Application Rate:** 3.19 Liters per square meter (l/m²).

1.3 Application Procedure

- **Preparation:** Ensure the area to be treated is free from debris and loose soil.
- **Mixing:** Dilute the chemical in water to achieve a 1% concentration.
- **Injection:** Inject the chemical emulsion into the soil using appropriate machinery to ensure even distribution.
 - **Under and Around Column Pits, Walls, Trenches, and Basement Excavation:** Apply the emulsion to create a barrier.
 - **Top Surface of Plinth Filling:** Treat the top surface before laying the floor.
 - **Junction of Wall and Floor:** Apply the emulsion at the junction to prevent termite entry.
 - **External Perimeter of Building:** Create a continuous barrier along the perimeter.
 - **Expansion Joints:** Treat all expansion joints to prevent termite ingress.
 - **Consolidated Earth for Apron:** Apply the emulsion over the top surface before laying the apron.
 - **Surrounding Pipes and Conduits:** Ensure thorough treatment around all pipes and conduits.

1.4 Execution

- **Labour and Machinery:** Utilize skilled labour and appropriate machinery for the application of the chemical emulsion.
- **Safety Measures:** Follow all safety protocols to protect workers and the environment during the application process.

1.5 Measurement and Payment

- **Measurement:** The plan area at the ground floor level will be measured for payment purposes.
- **Payment:** Payment will be made based on the measured area and the agreed rate, inclusive of the cost of chemicals, labour, and machinery usage.

2. Technical Specification for Customized Formwork for Waffle Slab Shuttering

NOT APPLICABLE

3. Technical Specification for Solid Concrete Block Masonry

3.1 Scope of Work

The work involves providing and constructing solid concrete block masonry in cement mortar 1:4 using precast blocks of specified sizes. This includes raking out joints, scaffolding, curing, providing and fixing wall ties, staging, and curing of blocks before and after construction. The work is to be completed in all respects and at all heights and levels as directed.

3.2 Materials

- **Concrete Blocks:** Precast solid concrete blocks of specified sizes with a minimum crushing strength of 40 kg/cm².
- **Cement Mortar:** Cement mortar mix in the ratio of 1:4 (1 part cement to 4 parts sand).
- **Wall Ties:** As per design specifications.
- **Scaffolding and Staging Materials:** Suitable for the height and level of work.

3.3 Application Procedure

- **Preparation:**
 - Ensure the surface is clean and free from debris.
 - Soak the concrete blocks in water before use.
- **Mixing Mortar:**
 - Prepare cement mortar in the ratio of 1:4.
 - Mix thoroughly to achieve a uniform consistency.
- **Laying Blocks:**
 - Lay the first course of blocks on a full bed of mortar.
 - Ensure blocks are properly aligned and levelled.
 - Apply mortar to the vertical joints and ensure they are fully filled.
- **Raking Joints:**
 - Rake out joints to a depth of 10 mm while the mortar is still green.
- **Wall Ties:**
 - Provide and fix wall ties as per design specifications at specified intervals.
- **Scaffolding and Staging:**
 - Erect scaffolding and staging as required for the height and level of work.
- **Curing:**
 - Cure the blocks before and after construction to ensure proper hydration and strength development.
 - Continue curing for at least 7 days after construction.

3.4 Execution

- **Quality Control:**
 - Ensure all materials comply with relevant industry standards and specifications.

- Inspect the work regularly to ensure proper alignment, levelling, and joint filling.
- **Safety Measures:**
 - Follow all safety protocols during the construction process.
 - Ensure scaffolding and staging are stable and secure.

3.5 Measurement and Payment

- **Measurement:** The area of the masonry work will be measured for payment purposes.
- **Payment:** Payment will be made based on the measured area and the agreed rate, inclusive of the cost of materials, labour, and machinery usage

4. Technical Specification for Exterior Grade Texture Paint with Non-Pigmented Stone Finish

4.1 Scope of Work

The work involves providing and applying exterior grade texture paint with a non-pigmented stone finish using natural mineral aggregates combined with adhesives and resins. The finish should be water repellent, anti-fungal, breathable, and have properties of elasticity and flexibility to prevent hairline cracks due to temperature variations. The coating is to be applied on exterior surfaces such as concrete and plastered surfaces, in the colour and pattern as directed by the engineer-in-charge.

4.2 Materials

- **Primer and Sealer:** Mixed in equal ratio.
- **Base Coat:** Made of natural stone crushed powder.
- **Second Coat:** Natural stone crushed powder with added granite chips.
- **Final Coat:** Ultra protect coat, diluted with water as per manufacturer's specifications.
- **Tools:** Steel trowel, acrylic trowel, spray gun, roller.

4.3 Application Procedure

- **Surface Preparation:**
 - Ensure the surface is clean, dry, and free from any loose particles.
 - Apply putty to prepare the base surface (included in the work and not paid separately).
- **Primer and Sealer Coat:**
 - Mix primer and sealer in equal ratio.
 - Apply one coat using a roller or brush.
- **Base Coat:**
 - Apply one coat of base coat with a steel trowel.
 - Use natural stone crushed powder for the base coat.
- **Second Coat:**
 - Apply the second coat with a steel trowel.
 - Finish with an acrylic trowel or spray gun.
 - Use natural stone crushed powder with added granite chips.
- **Final Coat:**
 - Apply the final coat of ultra - protect with a roller or spray.

- Dilute with water as per the manufacturer's specifications.

4.4 Execution

- **Quality Control:**
 - Ensure all materials comply with relevant industry standards and specifications.
 - Inspect the work regularly to ensure proper application and finish.
- **Safety Measures:**
 - Follow all safety protocols during the application process.
 - Ensure proper handling and storage of materials to avoid damage.

4.5 Measurement and Payment

- **Measurement:** The area of the surface treated will be measured for payment purposes.
- **Payment:** Payment will be made based on the measured area and the agreed rate, inclusive of the cost of materials, labour, and machinery usage.

4.6 Inspection and Approval

- All work will be subject to inspection and approval by the architect or engineer-in-charge.
- Any deficiencies such as bulging or other defects must be rectified at the contractor's expense.

5. Technical Specification for 24mm Clear DGU

5.1 Scope of Work

The work involves providing and fixing a 24mm Clear Double-Glazed Unit (DGU) consisting of 6mm clear toughened glass, a 12mm air gap, and another 6mm clear toughened glass. The DGU will be pasted on a fully unitized framework using structural silicones. Contractor should take approval from the technical sanctioning authority of IIIT, Sri City before procurement of Glass.

5.2 Materials

- **Glass Composition:**
 - **Outer Layer:** 6mm Neutral toughened glass (SKN 144) with high-performance soft Low-E coating on face #2.
 - **Air Gap:** 12mm air gap.
 - **Inner Layer:** 6mm clear toughened glass.
 - The properties of the glass shall be decided by the technical sanctioning authority based on site requirements. The colour of the glass should match the existing Academic Block or as decided by the sanctioning authority.
- **Structural Silicones:** Suitable for bonding the glass to the unitized framework.
- **Framework:** Fully unitized framework designed to support the DGU.

5.3 Glass Specifications

- **Visible Light Transmittance (VLT):** 59%

- **Light Reflection Internal:** 17%
- **Light Reflection External:** 16%
- **Shading Coefficient:** 0.37
- **U-Value:** Less than 1.5 W/m²·K

5.4 Application Procedure

- **Preparation:**
 - Ensure the framework is clean, dry, and free from any contaminants.
 - Verify the dimensions and alignment of the framework.
- **Installation:**
 - Apply structural silicones to the framework as per the manufacturer's instructions.
 - Position the DGU carefully onto the framework, ensuring proper alignment.
 - Press the DGU firmly to ensure a strong bond with the structural silicones.
- **Sealing:**
 - Ensure all edges are properly sealed to prevent air and water infiltration.
 - Check for any gaps or misalignments and rectify them immediately.

5.5 Execution

- **Quality Control:**
 - Ensure all materials comply with relevant industry standards and specifications.
 - Inspect the installation regularly to ensure proper bonding and alignment.
- **Safety Measures:**
 - Follow all safety protocols during the installation process.
 - Use appropriate personal protective equipment (PPE) for handling glass and silicones.

5.6 Measurement and Payment

- **Measurement:** The area of the installed DGU will be measured for payment purposes.
- **Payment:** Payment will be made based on the measured area and the agreed rate, inclusive of the cost of materials, labour, and machinery usage.

5.7 Inspection and Approval

- All work will be subject to inspection and approval by the technical sanctioning authority.
- The properties of the performance glass shall be decided as per the site requirements.

6. Technical Specification for Single Glazed Unit in Aluminium Doors, Windows, Ventilator Shutter and Partitions

6.1 Scope:

This specification covers the supply and installation of single glazed units in aluminium doors, windows, ventilator shutters, and partitions, complete with EPDM rubber/

neoprene gaskets, as per the architectural drawings and the directions of the engineer-in-charge. Contractor should take approval from the technical sanctioning authority of IIIT, Sri City before procurement of Glass.

6.2 Materials:

1. **Aluminium Sections:** The aluminium sections shall be of approved make and conform to IS 733 and IS 1285. The sections shall be anodized/powder-coated to a minimum thickness of 50 microns.
2. **Glass:** The glass shall be performance glass of approved make and model, such as ST 136 of Saint-Gobain, Nectar Clear SC 33/35 of Asahi, or an approved equivalent. The properties of the glass shall be decided by the technical sanctioning authority based on site requirements. The colour of the glass should match the existing Academic Block or as decided by the sanctioning authority.
3. **Gaskets:** EPDM rubber/neoprene gaskets shall be used to ensure a weather-tight seal.

6.3 Installation:

1. **Preparation:** Ensure that all aluminium sections are cut to the required lengths and that all necessary holes and slots are pre-drilled as per the architectural drawings.
2. **Frame Assembly:** Assemble the aluminium frames using corner cleats and screws. Ensure that the frames are square and true to the specified dimensions.
3. **Glazing:** Place the glass panels into the frames, ensuring that they are properly seated on setting blocks. Secure the glass with glazing beads and EPDM rubber/neoprene gaskets to provide a weather-tight seal.
4. **Fixing:** Fix the assembled frames into the openings using appropriate fasteners. Ensure that the frames are plumb, level, and securely fixed.
5. **Sealing:** Apply a weatherproof sealant around the perimeter of the frames to prevent water ingress.

6.4 Performance Requirements:

1. **Thermal Performance:** The glass units shall provide adequate thermal insulation as per the site requirements.
2. **Acoustic Performance:** The glass units shall provide sound insulation to meet the specified acoustic performance criteria.
3. **Safety and Security:** The glass units shall be toughened or laminated to provide safety and security as per the relevant standards.

6.5 Quality Assurance:

1. **Inspection:** All materials and workmanship shall be subject to inspection and approval by the engineer-in-charge.
2. **Testing:** The installed units shall be tested for water tightness, air infiltration, and structural performance as per the relevant standards.

Makes and Models: - **Saint-Gobain:** COOL-LITE® ST 136/ **Asahi:** Nectar Clear SC 33/35/ As per the approval of the technical sanctioning authority.

7. Technical Specification for 50 Micron Powder Coating over MS Work

7.1 General Description:

- **Product Name:** Powder Coating for Mild Steel (MS)
- **Coating Thickness:** 50 microns
- **Material:** Thermosetting powder coatings based on synthetic resins, hardeners, pigments, fillers, and additives.

7.2 Standards and Compliance:

- **IS Code Compliance:** The product should comply with IS 13871:1993 (Specification for Powder Coatings).

7.3 Surface Preparation:

- **Cleaning:** The MS surface should be cleaned to remove all grease, oil, dirt, and other contaminants.
- **Pre-treatment:** Surface treatment by shot blasting or phosphating is recommended to ensure proper adhesion of the powder coating.

7.4 Powder Coating Application:

- **Application Method:** Electrostatic spraying, tribostatic spraying, or fluidized bed coating.
- **Curing Schedule:** As per the supplier's recommendations, typically involving stoving at a specified temperature and duration to achieve proper curing.

7.5 Physical Properties:

- **Film Thickness:** 50-60 microns
- **Finish:** Smooth and continuous film
- **Gloss:** As per the grade specified (Glossy, Semi-glossy, or Matt)
- **Scratch Hardness:** No scratches showing bare metal when tested with a 3000g load
- **Flexibility:** No visible damage or detachment of the film when bent around a 6.25mm mandrel
- **Cross Cut Adhesion:** No visible damage or detachment of the film
- **Impact Resistance:** Minimum 150 kg/cm (direct/reverse)

7.6 Quality Assurance:

- **Inspection:** Each batch should be inspected for film thickness, adhesion, flexibility, and other specified properties.
- **Certification:** Supplier should provide a certificate of compliance with IS 13871:1993.

8. Technical Specification for Powder Coated Aluminium Windows**8.1 Scope of Work**

The work involves providing and fixing powder-coated aluminium windows using extruded built-up, standard tubular, and other sections from approved manufacturers such as Technal, Kawneer, Fasado, Wicono, Sapa, Vitrosca, or Vs1. The aluminium sections must conform to IS: 1285 and be powder-coated to the required shade with a minimum coating thickness of 60 microns.

8.2 Materials

- **Aluminium Sections:** Extruded built-up, standard tubular, and other sections as per the approved list of makes.
- **Powder Coating:** Minimum 60 microns average thickness, in the required shade.
- **Corner Cleats:** Special aluminium die-cast corner cleats for mechanical joints.
- **Gaskets:** Microwave cured EPDM gaskets for glazing/panelling.
- **Screws:** Stainless steel screws.
- **Handles:** 4-point locking handles from Alualpha, Giesse, or Caldwell.
- **Friction Stays:** From Security Style UK, Cotswold, or Giesse.

8.3 Application Procedure

- **Preparation:**
 - Ensure all aluminium sections are smooth, rust-free, straight, and mitred.
 - Clean the sections thoroughly before installation.
- **Fabrication:**
 - Mechanically join the sections using special aluminium die-cast corner cleats.
 - Use aluminium snap-on beading with microwave cured EPDM gaskets for glazing/panelling.
- **Installation:**
 - Fix the aluminium windows as per the architectural drawings and directions.
 - Secure the windows using stainless steel screws.
 - Install handles with 4-point locking mechanisms and friction stays as specified.
- **Finishing:**
 - Ensure all joints are properly sealed and the windows are aligned correctly.
 - Check for smooth operation of handles and friction stays.

8.4 Execution

- **Quality Control:**
 - Ensure all materials comply with relevant industry standards and specifications.
 - Inspect the work regularly to ensure proper installation and finish.
- **Safety Measures:**
 - Follow all safety protocols during the installation process.
 - Use appropriate personal protective equipment (PPE) for handling and installing aluminium sections.

8.5 Measurement and Payment

- **Measurement:** The area of the installed aluminium windows will be measured for payment purposes.
- **Payment:** Payment will be made based on the measured area and the agreed rate, inclusive of the cost of materials, labour, and machinery usage.

8.6 Inspection and Approval

- All work will be subject to inspection and approval by the architect or engineer-in-charge.

- Any deficiencies such as misalignment, improper sealing, or operational issues must be rectified at the contractor's expense.

9. **Technical Specification for Single Leaf Shutter Frame Profile**

9.1 General Description:

- **Product Name:** Single Leaf Shutter Frame Profile
- **Profile Size:** 125mm x 55mm
- **Material:** 1.2mm thick Galvanized Iron (GI)
- **Galvanization:** 120 GSM (grams per square meter)
- **Frame Type:** Grooved frame with PVC smoke seal

9.2 Standards and Compliance:

- **IS Code Compliance:** The product should comply with IS 277:2003 (Specification for Galvanized Steel Sheets).

9.3 Physical Properties:

- **Thickness:** 1.2mm $\pm$ 0.1mm
- **Density:** 7.85 g/cm³ (typical for steel)
- **Galvanization:** 120 GSM, ensuring adequate corrosion resistance

9.4 Dimensions and Tolerances:

- **Width:** 125mm $\pm$ 1mm
- **Height:** 55mm $\pm$ 1mm
- **Length:** As specified (commonly available in 2m, 3m, or custom lengths)
- **Groove Depth:** As per design requirements to accommodate PVC smoke seal

9.5 Surface Finish:

- **Powder Coating:** Minimum 50 microns thick
- **Colour:** As specified by the client (commonly available in a range of RAL colours)
- **Finish Quality:** Smooth, uniform, and free from defects such as blisters, runs, or sags

9.6 Installation:

- **Anchors:** Suitable anchors provided for secure fixing
- **Grouting:** Puff grouting included to ensure stability and proper alignment
- **Mounting:** Frame to be fixed using appropriate methods (e.g., screws, bolts) as per site requirements

9.7 Applications:

- Suitable for use in residential, commercial, and industrial buildings
- Commonly used in doors for utility rooms, general applications, and areas requiring smoke sealing

9.8 Quality Assurance:

- **Inspection:** Each batch should be inspected for dimensional accuracy, coating thickness, and visual defects
- **Certification:** Supplier should provide a certificate of compliance with IS 277

9.9 Packaging and Storage:

- **Packaging:** Individually wrapped or bulk packed in protective material to prevent damage during transit
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures

10. Technical Specification for 1.0 mm Thick PVC Laminate on Flush Door Surface**10.1 General Description:**

- **Product Name:** PVC Laminate
- **Thickness:** 1.0 mm
- **Shade:** As approved by the client
- **Application:** Over flush door surface

10.2 Standards and Compliance:

- **IS Code Compliance:** The product should comply with IS 2046:1995 (Specification for Decorative Laminates).

10.3 Material Properties:

- **Base Material:** Polyvinyl Chloride (PVC)
- **Thickness:** 1.0 mm $\pm$ 0.1 mm
- **Surface Finish:** Smooth, matt, or glossy as specified
- **Colour Fastness:** High resistance to fading and discoloration

10.4 Adhesive:

- **Type:** Suitable adhesive of approved quality (e.g., contact adhesive, synthetic resin adhesive)
- **Application:** As per manufacturer's recommendations to ensure strong bonding

10.5 Surface Preparation:

- **Cleaning:** Ensure the flush door surface is clean, dry, and free from dust, grease, and other contaminants.
- **Sanding:** Lightly sand the surface to ensure better adhesion of the laminate.

10.6 Laminate Application:

- **Cutting:** Cut the PVC laminate to the required size, ensuring clean and straight edges.
- **Adhesive Application:** Apply adhesive evenly on both the laminate and the door surface.
- **Fixing:** Carefully place the laminate on the door surface, starting from one edge and pressing down firmly to avoid air bubbles.
- **Rolling:** Use a roller to press the laminate firmly onto the surface, ensuring even adhesion and removing any air pockets.

10.7 Finishing:

- **Trimming:** Trim any excess laminate from the edges using a sharp blade.
- **Edge Sealing:** Seal the edges with matching PVC edge banding or sealant to prevent moisture ingress.

10.8 Quality Assurance:

- **Inspection:** Inspect the finished surface for uniformity, adhesion, and absence of defects such as bubbles, wrinkles, or gaps.
- **Certification:** Supplier should provide a certificate of compliance with IS 2046:1995.

10.9 Packaging and Storage:

- **Packaging:** Laminate sheets should be packed flat in protective material to prevent damage during transit.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

11. Technical Specification for Fire Doors (Double Leaf Dorset)**11.1 General Description:**

- **Product Name:** Fire Door Double Leaf Dorset
- **Fire Rating:** 120 minutes integrity, 30 minutes insulation
- **Standards:** IS 3614:2021, tested to IS/ISO 3008

11.2 Frame:

- **Profile:** Grooved step frame profile
- **Dimensions:** 125mm x 75mm
- **Material:** 1.2mm thick Galvanized Iron (GI)
- **Galvanization:** 120 GSM (grams per square meter)
- **Smoke Seal:** EPDM smoke seal included

11.3 Shutter:

- **Thickness:** 60mm
- **Material:** 1.2mm thick Galvanized Iron (GI)
- **Galvanization:** 120 GSM
- **Infill:** 120 kg/m³ density mineral wool

11.4 Hardware:

- **Hinges:** Minimum 6 stainless steel (SS) ball bearing hinges, SS304, size 100x89x3mm
- **Panic Device (Active Leaf):** Single point panic device with external trim and key cylinder, tested as per EN1125 and CE marked
- **Panic Device (Inactive Leaf):** Two-point panic device, tested as per EN1125 and CE marked
- **Door Closers:** 2 door closers with spring size EN 3-5, as per EN1154 and CE marked
- **Door Coordinator:** 1 door coordinator for sequencing

11.5 Vision Panels:

- **Quantity:** 2
- **Size:** 200mm x 300mm
- **Glass:** 6mm clear fire-rated glass

11.6 Surface Finish:

- **Powder Coating:** Minimum 50 microns thick

- **Colour:** As specified by the client

11.7 Installation:

- **Anchors:** Suitable anchors included
- **Grouting:** Fire-rated puff grouting included for fixing the doorset

11.8 Applications:

- Suitable for staircase, exit pathways, and refuge area applications

11.9 Quality Assurance:

- **Inspection:** Each doorset should be inspected for compliance with the specified standards and performance criteria
- **Certification:** Supplier should provide a certificate of compliance with IS 3614:2021 and relevant EN standards

11.10 Packaging and Storage:

- **Packaging:** Doorsets should be packed in protective material to prevent damage during transit
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures

12. Technical Specification for Aluminium Powder-Coated Louvered Shutter

12.1 General Description:

- **Product Name:** Aluminium Powder-Coated Louvered Shutter
- **Material:** Aluminium
- **Finish:** Powder-coated in the desired colour
- **Application:** As per the direction of Engineer-in-charge/Architect

12.2 Dimensions and Shape:

- **Profile:** Louvered design with required shape and dimensions as specified by the Engineer-in-charge/Architect
- **Thickness:** As per design requirements

12.3 Material Properties:

- **Powder Coating Thickness:** Minimum 50 microns
- **Colour:** As approved by the client

12.4 Louvers:

- **Type:** Fixed or adjustable as per design requirements
- **Spacing:** Uniform spacing to ensure adequate ventilation and aesthetic appeal

12.5 Frame:

- **Material:** Aluminium
- **Profile:** As per design requirements
- **Finish:** Powder-coated to match the louvers

12.6 Fittings and Fixtures:

- **Hinges:** Stainless steel (SS) ball bearing hinges, SS304, size 100x75x3mm or as specified

- **Handles:** Aluminium or stainless steel handles as per design
- **Locks:** Suitable locking mechanism as per security requirements
- **Fasteners:** Stainless steel screws and bolts

12.7 Installation:

- **Anchors:** Suitable anchors provided for secure fixing
- **Grouting:** Puff grouting included to ensure stability and proper alignment
- **Mounting:** Frame to be fixed using appropriate methods (e.g., screws, bolts) as per site requirements

12.8 Surface Finish:

- **Powder Coating:** Minimum 50 microns thick
- **Colour:** As specified by the client
- **Finish Quality:** Smooth, uniform, and free from defects such as blisters, runs, or sags

12.9 Environmental Resistance:

- **Corrosion Resistance:** Enhanced by powder coating
- **UV Resistance:** UV stabilized to prevent discoloration and degradation
- **Weather Resistance:** Suitable for exterior applications, resistant to rain and wind

12.10 Quality Assurance:

- **Inspection:** Each shutter should be inspected for dimensional accuracy, coating thickness, and visual defects
- **Certification:** Supplier should provide a certificate of compliance with relevant standards

12.11 Packaging and Storage:

- **Packaging:** Shutters should be packed in protective material to prevent damage during transit
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures

13. Technical Specification for Acoustical Micro Look Edge Tiles

13.1 Scope of Work

The work involves providing and installing acoustical micro look edge tiles of size 600x600mm and 15mm thickness. The tiles should be easily demountable, suitable for weekly dusting and vacuum cleaning, and manufactured from high-density glass wool utilizing 3RD Technology. The visible surface should be batch painted glass tissue in white, with the back of the tile covered with glass tissue.

13.2 Materials

- **Acoustical Tiles:**
 - Size: 600x600mm
 - Thickness: 15mm
 - Material: High-density glass wool
 - Surface: Batch painted glass tissue in white
 - Back: Covered with glass tissue

- Light Reflectance: 83%
- Sound Absorption Class: A
- Alpha w Value: 0.95 at minimum 200mm o.d.s.
- NRC Value: 0.9 (ASTM C 423)
- Colour: White 500 (nearest NCS colour sample S 0500-N)
- Humidity Resistance: Up to 95% RH at 30°C (ISO 4611)

13.3 Framing System

- **Gypsteel Pre-Coated GI T Grid System:**
 - Module: 600x600mm
 - Wall Angle: Fixed along the perimeter with nylon sleeves and wooden screws at 300mm centres
 - Main Tee: Suspended from the soffit with soffit cleat, rawl plugs, and wire rod with levelling spring clip at 1200mm c/c
 - Cross Tees: Interlocked into pre-cut slots in the main tees at 600mm centres and 1200mm centres
 - Dimensions:
 - Main Runner 'T' Section: 14x38mm, 3.6m long
 - Cross Runner 'T' Section: 14x25mm, 1.2/0.6m long
 - Perimeter Wall Angle: 19x19mm, 3.05m long

13.4 Application Procedure

- **Preparation:**
 - Ensure the surface is clean and free from debris.
 - Install wall angles along the perimeter.
- **Installation:**
 - Suspend the main tee from the soffit.
 - Interlock cross tees into the main tees to form a grid.
 - Hang Axiom trim sections onto the grid system.
 - Secure all connections and ensure proper alignment.
- **Finishing:**
 - Install and secure splice plates, corner pieces, and alignment plates.
 - Make necessary adjustments for proper alignment.

13.5 Execution

- **Quality Control:**
 - Ensure all materials comply with relevant industry standards and specifications.
 - Inspect the work regularly to ensure proper installation and finish.
- **Safety Measures:**
 - Follow all safety protocols during the installation process.
 - Use appropriate personal protective equipment (PPE) for handling materials.

13.6 Measurement and Payment

- **Measurement:** The area of the installed acoustical tiles will be measured for payment purposes.
- **Payment:** Payment will be made based on the measured area and the agreed rate, inclusive of the cost of materials, labour, and machinery usage.

13.7 Inspection and Approval

- All work will be subject to inspection and approval by the architect or engineer-in-charge.
- Any deficiencies such as misalignment, improper sealing, or operational issues must be rectified at the contractor's expense.

14. Technical Specification for PU-Based Waterproofing Treatment

14.1 General Description:

- **Product Name:** PU-Based Single Component Elastomeric Pure Polyurethane Coating
- **Application Areas:** New terrace & chajjas
- **Type:** Cold applied PU waterproofing membrane

14.2 Material Properties:

- **Elongation:** Greater than 400% (as per ASTM D412)
- **Tensile Strength:** Greater than 2 MPa (as per ASTM D412)
- **Dry Film Thickness (DFT):** 1mm

14.3 Application Details:

- **Primer Coat:** Epoxy primer applied at 150 g/m²
- **Waterproofing Membrane:** Applied in 2 coats at 1.6 kg/m² to achieve the final DFT of 1mm
- **Protection Layer:** 120gsm Geo-textile over the waterproofing membrane

14.4 Surface Preparation:

- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants.
- **Coving:** Make coving at junctions to ensure smooth transitions and prevent water ingress.
- **Bore Packing:** Properly seal any boreholes or penetrations.

14.5 Application Process:

- **Primer Application:** Apply the epoxy primer uniformly at 150 g/m² and allow it to dry.
- **First Coat:** Apply the first coat of the PU waterproofing membrane at 1.6 kg/m².
- **Second Coat:** After the first coat has cured, apply the second coat at 1.6 kg/m² to achieve the desired thickness.
- **Geo-Textile Layer:** Place the 120gsm Geo-textile over the cured waterproofing membrane for added protection.

14.6 Treatment of Construction Joints:

- **Joint Treatment:** Ensure all construction joints are treated as per the specification to prevent leakage.

14.7 Quality Assurance:

- **Inspection:** Inspect the surface preparation, application of primer, and each coat of the waterproofing membrane.
- **Certification:** Supplier should provide a certificate of compliance with the specified standards.

14.8 Warranty:

- **Duration:** 10 years warranty on product and workmanship
- **Provider:** Certified manufacturers

14.9 Installation:

- **Supervision:** All work to be carried out under the direction of the Engineer In charge.
- **Anchors and Grouting:** Include suitable anchors and fire-rated puff grouting for fixing.

14.10 Packaging and Storage:

- **Packaging:** Materials should be packed in moisture-proof containers.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

15. Technical Specification for Polyurethane Foam (PUF) Slab Insulation**15.1 General Description:**

- **Product Name:** Polyurethane Foam (PUF) Slab Insulation
- **Thickness:** 60mm (average)
- **Density:** $36 \pm 2 \text{ kg/m}^3$

15.2 Application Areas:

- Over deck insulation
- Suitable for terraces, chajjas, and sunken portions of WC/Bathroom

15.3 Material Properties:

- **PUF Slab:** Rigid polyurethane foam with a density of $36 \pm 2 \text{ kg/m}^3$
- **Thermal Conductivity:** Low thermal conductivity for effective insulation

15.4 Surface Preparation:

- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants.
- **Coving:** Make coving at junctions to ensure smooth transitions and prevent water ingress.
- **Bore Packing:** Properly seal any boreholes or penetrations.

15.5 Application Process:

- **Primer Application:** Apply an epoxy-based bonding adhesive uniformly on the prepared surface.
- **PUF Slab Installation:** Fix the 60mm thick PUF slabs over the primed surface.
- **Polymerized Plaster:** Apply polymerized plaster reinforced with glass fibre mesh over the PUF slabs for added strength and durability.

15.6 Concrete Screed:

- **First Layer:** Apply the first layer of 40mm thick cement concrete screed with a mix proportion of 1:1.5:3 (M20 grade).
- **Second Layer:** After the first layer has set, apply the second layer of 40mm thick cement concrete screed with the same mix proportion.
- **Finishing:** Smooth finish with a floating coat of neat cement to ensure a uniform and level surface.

15.7 Quality Assurance:

- **Inspection:** Inspect the surface preparation, application of primer, and each layer of the PUF slab and concrete screed.
- **Certification:** Supplier should provide a certificate of compliance with relevant standards.

15.8 Warranty:

- **Duration:** 10 years warranty on product and workmanship
- **Provider:** Certified manufacturers

15.9 Installation:

- **Supervision:** All work to be carried out under the direction of the Engineer In charge.
- **Anchors and Grouting:** Include suitable anchors and fire-rated puff grouting for fixing.

15.10 Packaging and Storage:

- **Packaging:** Materials should be packed in moisture-proof containers.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

16. Technical Specification for PU-Based Elastomeric Liquid Applied PU Waterproofing Membrane**16.1 General Description:**

- **Product Name:** PU-Based Elastomeric Liquid Applied PU Waterproofing Membrane
- **Type:** Single component, cold applied, water-based acrylic PU dispersion
- **Application Areas:** sunken portions of WC/Bathroom

16.2 Material Properties:

- **Tensile Strength:** Greater than 1.5 N/mm² (as per ASTM D412)
- **Elongation:** Greater than 300% (as per ASTM D412)
- **Solid Content:** Not less than 60%
- **UV Resistance:** High resistance to UV radiation

16.3 Application Details:

- **Primer Coat:** Water-based acrylic primer applied at 0.1 L/m²
- **Waterproofing Membrane:** Applied in 2 coats at 1.2 L/m² to achieve the desired thickness
- **Protection Layer:** 60 GSM Geotextile spread between the two topcoats

16.4 Surface Preparation:

- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants.
- **Coving:** Make coving at junctions to ensure smooth transitions and prevent water ingress.
- **Bore Packing:** Properly seal any boreholes or penetrations.

16.5 Application Process:

- **Primer Application:** Apply the water-based acrylic primer uniformly at 0.1 L/m² and allow it to dry.
- **First Coat:** Apply the first coat of the PU waterproofing membrane at 1.2 L/m².
- **Geotextile Layer:** Place the 60 GSM Geotextile over the first coat while it is still wet.
- **Second Coat:** After the first coat has cured, apply the second coat at 1.2 L/m² to achieve the desired thickness.

16.6 Treatment of Construction Joints:

- **Joint Treatment:** Ensure all construction joints are treated as per the specification to prevent leakage.

16.7 Quality Assurance:

- **Inspection:** Inspect the surface preparation, application of primer, and each coat of the waterproofing membrane.
- **Certification:** Supplier should provide a certificate of compliance with the specified standards.

16.8 Warranty:

- **Duration:** 10 years warranty on product and workmanship
- **Provider:** Certified manufacturers

16.9 Installation:

- **Supervision:** All work to be carried out under the direction of the Engineer In charge.
- **Anchors and Grouting:** Include suitable anchors and fire-rated puff grouting for fixing.

16.10 Packaging and Storage:

- **Packaging:** Materials should be packed in moisture-proof containers.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

17. Technical Specification for Broken AAC Block in Sunken Filling**17.1 General Description:**

- **Product Name:** Broken AAC Block in Sunken Filling
- **Application Areas:** Sunken portions of bathrooms, toilets, and other wet areas
- **Mix:** Broken AAC blocks mixed with manufactured or natural sand

17.2 Material Properties:

- **AAC Blocks:** Autoclaved Aerated Concrete (AAC) blocks, broken into smaller pieces
- **Sand:** Manufactured or natural sand, clean and free from impurities

17.3 Material Specifications:

- **AAC Block Density:** Typically, 550-650 kg/m³
- **Sand Grading:** As per IS 383:2016 (Specification for Coarse and Fine Aggregates)

17.4 Surface Preparation:

- **Cleaning:** Ensure the sunken area is clean, dry, and free from debris and contaminants.
- **Priming:** Apply a suitable primer if required to enhance bonding.

17.5 Application Process:

- **Mixing:** Mix broken AAC blocks with manufactured or natural sand in the required proportion.
- **Layering:** Lay the mixture in layers, ensuring each layer is compacted properly.
- **Compaction:** Compact each layer using appropriate tools to achieve a dense and stable fill.

17.6 Finishing:

- **Top Layer:** Ensure the top layer is level and smooth to receive subsequent flooring or waterproofing treatments.
- **Curing:** Allow the filled area to cure properly before proceeding with further construction activities.

17.7 Quality Assurance:

- **Inspection:** Inspect the materials and the filled area for compliance with the specified standards and performance criteria.
- **Certification:** Supplier should provide a certificate of compliance with relevant standards.

17.8 Installation:

- **Supervision:** All work to be carried out under the direction of the Engineer-in-charge/Architect.
- **Safety Measures:** Ensure all safety measures are followed during the mixing and laying process.

18. Technical Specification for 200-Micron Polythene Sheet

18.1 General Description:

- **Product Name:** Polythene Sheet
- **Thickness:** 200 microns
- **Application Areas:** Suitable for use as a damp-proof membrane, vapour barrier, or protective layer

18.2 Material Properties:

- **Material:** Low-density polyethylene (LDPE)

- **Thickness:** 200 microns (0.2 mm)
- **Colour:** Typically, black or clear, as specified

18.3 Standards and Compliance:

- **IS Code Compliance:** The product should comply with IS 2508:1984 (Specification for Low-Density Polyethylene Films).

18.4 Application Details:

- **Overlap:** Minimum overlap of 150mm at jointing areas
- **Sealing:** Joints should be sealed using 50mm wide duct tape or an approved adhesive to ensure continuity and prevent moisture ingress

18.5 Surface Preparation:

- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants.
- **Levelling:** Make sure the surface is level and smooth to avoid punctures or tears in the polythene sheet.

18.6 Installation Process:

- **Laying:** Unroll the polythene sheet and lay it flat on the prepared surface.
- **Overlapping:** Ensure a minimum overlap of 150mm at all jointing areas.
- **Sealing Joints:** Seal the overlaps with 50mm wide duct tape or an approved adhesive to create a continuous barrier.
- **Edge Treatment:** Extend the polythene sheet up the sides of walls or other vertical surfaces to ensure complete coverage and protection.

18.7 Quality Assurance:

- **Inspection:** Inspect the polythene sheet for any tears, punctures, or defects before and after installation.
- **Certification:** Supplier should provide a certificate of compliance with IS 2508:1984.

18.8 Installation Supervision:

- **Direction:** All work to be carried out under the direction of the Engineer-in-charge/Architect.
- **Safety Measures:** Ensure all safety measures are followed during the installation process.

18.9 Packaging and Storage:

- **Packaging:** Polythene sheets should be packed in rolls and protected from damage during transit.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

19. Technical Specification for Waterproofing Treatment of Water Tanks & Liquid Retaining Structures

19.1 General Description:

- **Product Name:** Two-component acrylic polymer modified cementitious waterproofing membrane
- **Application Areas:** Internal side waterproofing of water tanks and liquid retaining structures

19.2 Material Properties:

- **Elongation:** Minimum 50% (as per ASTM D412)
- **Application Rate:** 1.5 kg/m²
- **Coating Layers:** Two layers with a waiting period of 4-6 hours between layers
- **Food Grade Epoxy Coating:** Two coats, certified by CFTRI Mysuru

19.3 Surface Preparation:

- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants.
- **Priming:** Apply a suitable primer if required to enhance bonding.

19.4 Application Process:

- **First Layer:** Apply the first layer of the acrylic polymer modified cementitious waterproofing membrane at 1.5 kg/m².
- **Waiting Period:** Allow a waiting period of 4-6 hours for the first layer to cure.
- **Second Layer:** Apply the second layer at the same rate to achieve the desired thickness.
- **Epoxy Coating:** After the waterproofing membrane has cured, apply two coats of food grade epoxy coating.

19.5 Protection Layer:

- **Geotextile:** Spread 60 GSM Geotextile between the two top coats for added protection.

19.6 Treatment of Construction Joints:

- **Joint Treatment:** Ensure all construction joints are treated as per the specification to prevent leakage.

19.7 Quality Assurance:

- **Inspection:** Inspect the surface preparation, application of primer, and each coat of the waterproofing membrane.
- **Certification:** Supplier should provide a certificate of compliance with the specified standards.

19.8 Warranty:

- **Duration:** 10 years warranty on product and workmanship
- **Provider:** Certified manufacturers

19.9 Installation:

- **Supervision:** All work to be carried out under the direction of the Engineer In charge/PMC/Architect.

- **Safety Measures:** Ensure all safety measures are followed during the installation process.

19.10 Packaging and Storage:

- **Packaging:** Materials should be packed in moisture-proof containers.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

20. Technical Specification for Chemical Injection Grout Waterproofing

20.1 General Description:

- **Product Name:** Chemical Injection Grout Waterproofing
- **Application Areas:** Retaining walls, basement raft, and underground sump raft

20.2 Material Properties:

- **Nozzles:** 25mm diameter mild steel (M.S) nozzles
- **Grout:** Cement slurries of different viscosities with waterproofing grout @ 225 gm/50 kg of cement or approved equivalent make conforming to IS 2645

20.3 Installation Details:

- **Nozzle Insertion:** Insert nozzles to a minimum of 1/3 thickness of walls and 1/3 thickness of basement raft
- **Nozzle Placement:** Place and fix nozzles at 0.7m centre-to-centre (C/C) distance in both directions and at 0.75m C/C along construction joints

20.4 Surface Preparation:

- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants.
- **Priming:** Apply a suitable primer if required to enhance bonding.

20.5 Application Process:

- **Grout Injection:** Inject cement slurries of different viscosities under pressure using a pump
- **Pressure:** Maintain appropriate pressure to ensure effective penetration and filling of voids
- **Sealing Nozzles:** Seal the nozzles after the injection operation with a suitable admixture to prevent leakage

20.6 Quality Assurance:

- **Inspection:** Inspect the surface preparation, nozzle placement, and grout injection process for compliance with the specified standards and performance criteria
- **Certification:** Supplier should provide a certificate of compliance with IS 2645 and relevant standards

20.7 Warranty:

- **Duration:** 10 years warranty on product and workmanship
- **Provider:** Certified manufacturers

20.8 Installation Supervision:

- **Direction:** All work to be carried out under the direction of the Project-in-charge
- **Safety Measures:** Ensure all safety measures are followed during the installation process

20.9 Packaging and Storage:

- **Packaging:** Materials should be packed in suitable containers to prevent contamination
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures

21. Technical Specification for Chemical Rebaring of TMT Bars

21.1 General Description:

- **Product Name:** Chemical Rebaring of TMT Bars
- **Application Areas:** Structural connections in concrete, such as extensions, retrofits, and repairs

21.2 Material Properties:

- **Rebar:** Thermo-Mechanically Treated (TMT) bars
- **Chemical Adhesive:** HILTI or approved equivalent make, conforming to relevant standards

21.3 Installation Details:

- **Embedment Depth:** Minimum 12 times the diameter (12xDia) of the rebar
- **Nozzle Diameter:** 25mm or as specified by the manufacturer

21.4 Surface Preparation:

- **Cleaning:** Ensure the drilled holes are clean, dry, and free from dust, grease, and other contaminants.
- **Drilling:** Drill holes to the specified depth and diameter as per the rebar size and manufacturer's guidelines.

21.5 Application Process:

- **Adhesive Injection:** Inject the chemical adhesive into the drilled holes using a suitable injection system.
- **Rebar Insertion:** Insert the TMT bars into the holes filled with adhesive, ensuring proper alignment and coverage.
- **Curing:** Allow the adhesive to cure as per the manufacturer's specifications before applying any load.

21.6 Quality Assurance:

- **Inspection:** Inspect the drilled holes, adhesive application, and rebar insertion for compliance with the specified standards and performance criteria.
- **Certification:** Supplier should provide a certificate of compliance with relevant standards.

21.7 Warranty:

- **Duration:** As specified by the manufacturer

- **Provider:** Certified manufacturers

21.8 Installation Supervision:

- **Direction:** All work to be carried out under the direction of the Architect/Engineer-in-charge.
- **Safety Measures:** Ensure all safety measures are followed during the installation process.

21.9 Packaging and Storage:

- **Packaging:** Materials should be packed in suitable containers to prevent contamination.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

21.10 Pricing:

- **Scope:** Price is only for rebaring; the cost of TMT bars will be paid under the respective item.

22. Technical Specification for Chemical Anchor Fasteners

22.1 General Description:

- **Product Name:** Chemical Anchor Fasteners
- **Brand:** Hilti or approved equivalent
- **Application Areas:** Suitable for anchoring in concrete and masonry

22.2 Material Properties:

- **Anchor Rods:** High-strength steel, stainless steel, or galvanized steel as specified
- **Chemical Adhesive:** Hilti HIT-HY 200, HIT-RE 500 V3, or approved equivalent

22.3 Installation Details:

- **Embedment Depth:** As per manufacturer's specifications, typically 12 times the diameter (12xDia) of the anchor rod
- **Hole Diameter:** As specified by the manufacturer for the selected anchor rod and adhesive

22.4 Surface Preparation:

- **Cleaning:** Ensure the drilled holes are clean, dry, and free from dust, grease, and other contaminants.
- **Drilling:** Drill holes to the specified depth and diameter as per the anchor size and manufacturer's guidelines.

22.5 Application Process:

- **Adhesive Injection:** Inject the chemical adhesive into the drilled holes using a suitable injection system.
- **Anchor Insertion:** Insert the anchor rods into the holes filled with adhesive, ensuring proper alignment and coverage.
- **Curing:** Allow the adhesive to cure as per the manufacturer's specifications before applying any load.

22.6 Quality Assurance:

- **Inspection:** Inspect the drilled holes, adhesive application, and anchor insertion for compliance with the specified standards and performance criteria.
- **Certification:** Supplier should provide a certificate of compliance with relevant standards.

22.7 Warranty:

- **Duration:** As specified by the manufacturer
- **Provider:** Certified manufacturers

22.8 Installation Supervision:

- **Direction:** All work to be carried out under the direction of the Architect/Engineer-in-charge.
- **Safety Measures:** Ensure all safety measures are followed during the installation process.

22.9 Packaging and Storage:

- **Packaging:** Materials should be packed in suitable containers to prevent contamination.
- **Storage:** Store in a cool, dry place away from direct sunlight and extreme temperatures.

23. Technical Specification for Core Cutting in RCC Wall/Slab/Beam**23.1 General Description:**

- **Process Name:** Core Cutting
- **Application Areas:** RCC walls, slabs, and beams
- **Depth:** Up to 250mm

23.2 Equipment and Tools:

- **Core Drill Machine:** High-power core drilling machine with diamond-tipped core bits
- **Core Bits:** Diamond-tipped core bits of appropriate diameter as specified
- **Water Supply:** Continuous water supply system for cooling and dust suppression

23.3 Material Properties:

- **Concrete:** Reinforced concrete (RCC) with specified grade and reinforcement details
- **Reinforcement:** TMT bars or equivalent as per structural design

23.4 Surface Preparation:

- **Marking:** Accurately mark the location and diameter of the core to be cut on the RCC surface
- **Cleaning:** Ensure the surface is clean, dry, and free from dust, grease, and other contaminants

23.5 Core Cutting Process:

- **Drilling Setup:** Securely set up the core drill machine at the marked location

- **Drilling:** Begin drilling with a diamond-tipped core bit, maintaining a steady speed and pressure
- **Cooling:** Use continuous water supply to cool the core bit and suppress dust
- **Core Removal:** Carefully remove the drilled core from the hole

23.6 Safety Measures:

- **Personal Protective Equipment (PPE):** Ensure all workers wear appropriate PPE, including safety goggles, gloves, ear protection, and dust masks
- **Stability:** Ensure the core drill machine is stable and securely anchored to prevent movement during drilling
- **Electrical Safety:** Use proper electrical connections and ensure the equipment is grounded

23.7 Quality Assurance:

- **Inspection:** Inspect the core cut for accuracy in diameter, depth, and alignment
- **Certification:** Provide a certificate of compliance with relevant standards and specifications

23.8 Installation Supervision:

- **Direction:** All work to be carried out under the direction of the Engineer-in-charge
- **Documentation:** Maintain detailed records of the core cutting process, including location, depth, and any observations

23.9 Packaging and Storage:

- **Packaging:** Properly package and label the removed cores for further testing or disposal
- **Storage:** Store the core drill machine and accessories in a clean, dry place away from direct sunlight and moisture

24. Technical Specification for Epoxy flooring on ramp surface

24.1 Providing and laying epoxy flooring: This includes the application of an epoxy flooring system consisting of Nito prime 25, a 3mm thick layer of Nito Flor TF30, Anti slip Grain No.3, and a 0.5mm thick topcoat of Nito Flor FC150. The process involves the following steps:

24.2 Surface Preparation: Surface preparation shall be done using a vacuum-assisted high-speed electric grinding machine to remove all cement laitance, friable concrete, and loose mortar, achieving a CSP3 type profile for mechanical keys. Any part of the floor contaminated by grease, oil, or solvent shall be removed before preparation is undertaken. Cracks and cold joints, if any, shall be opened using a groove cutter machine or manual preparation as per site requirements.

24.3 Saw Cut Joints, Shrinkage Cracks, Cold & Construction Joints Treatment: Provide and apply a three-component, 100% solid, solvent-free epoxy resin-based putty with a mixed density of 1.6 g/cc. The epoxy putty shall be filled at designated grooves/joints to seal the saw cut/construction joints, providing a seamless (jointless) floor for epoxy flooring works. The epoxy putty shall have a minimum compressive strength of 50

N/mm². Work is to be strictly done by the manufacturer's authorized applicator.

24.4 Epoxy Primer & Epoxy Floor Screed Application: Provide and apply an average 3mm thick epoxy screed system prior to the anti-skid coating. First, apply a two-component epoxy resin-based adhesive primer on the well-cleaned and dry substrate at a coverage of 4.5-6.5 sqm/ltr (subject to substrate conditions). This shall be followed by laying a chemical and abrasion-resistant resin-rich epoxy floor screed at a coverage of 3.5-4.5 sqm/12L pack/3mm or as per the manufacturer's specification and methodology. The epoxy screed shall have the following typical properties:

- **Tensile Strength:** 13.5 N/mm² as per BS 6319 part 7
- **Compressive Strength:** 75 N/mm² as per BS 6319 part 2
- **Flexural Strength:** 26 N/mm² as per BS 6319 part 3
- **Bond Strength to Concrete:** 3 N/mm²
- **Mix Density:** 2.0 g/cc
- **Abrasion Resistance:** 3 mg/cycle

24.5 Anti slip Grain Finish Epoxy Resin Floor Coating: Supply and apply a base coat of Nito Flor FC150 and sprinkle antiship Grain No.3 at a coverage of 1.25-3.0 sqm/kg. Finish the surface with a topcoat of Nito Flor FC150, a high-build solvent-free textured finish abrasion and chemical-resistant epoxy resin floor coating, applied in two coats with a minimum thickness of 500 microns at coverage as per the manufacturer's specification. The coating shall have the following typical properties:

- **Compressive Strength:** 70 N/mm² @ 7 days
- **Tensile Strength:** 18.5 N/mm²
- **Flexural Strength:** 36 N/mm²
- **Bond Strength to Concrete:** 1.5 N/mm²
- **Abrasion Resistance (1000 cycles, 1kg load, CS10 wheel):** <100 mg loss

24.6 Line Marking: Provide and apply high-performance epoxy resin floor coating Nito Flor FC140 as per the drawings or direction of the Engineer-in-Charge (EIC).

FORMATS FOR GUARANTEES

GUARANTEE TO BE EXECUTED BY THE CONTRACTOR FOR REMOVAL OF
DEFECTS AFTER COMPLETION IN RESPECT OF WATER SUPPLY AND SANITARY
INSTALLATIONS

(On a Non-Judicial Stamp Paper of Rupees 100 (Rupees Due hundred))

**The agreement made this Day of Two thousand and
between**

S/O (hereinafter called the GUARANTOR of the one part) and the -----
----- (herein after called the IIIT, SRICITY of the other part). WHEREAS THIS
agreement is supplementary to the contract. (Herein after called the Contract) dated
and made between the GUARANTOR OF THE ONE PART AND the IIIT, SRICITY of the
other part, whereby the contractor, undertook to render the work in the said contract recited
structurally stable workmanship and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said
work will remain structurally stable and guarantee against faulty workmanship, finishing,
manufacturing defects of materials and leakages etc.

NOW THE GUARANTOR hereby guarantees that work executed by him will remain
structurally stable, after the expiry of maintenance period prescribed in the contract for the
minimum life of ten years, to be reckoned from the date of completion of work, to be reckoned
after the expiry of maintenance period

prescribed in the contract.

The decision of the Engineer-in-charge with regard to nature and cause of defects shall be final.

During the period of guarantee the guarantor shall make good all defects to the satisfaction of
the Engineer-in-charge calling upon him to rectify the defects, failing which the work shall be
got done by the IIIT, SRICITY by some other contractor at the guarantor's cost and risk. The
decision of the Engineer -in-charge as to the cost payable by the Guarantor shall be final and
binding.

That if the guarantor fails to make good all the defects, commits breach there-under then the
guarantor will indemnify the principal and his successor against all loss, damage cost expense
or otherwise which may be incurred by him by reason of any default on the part of THE
GUARANTOR in performance and observance of this supplementary agreement. As to the
amount of Loss and/or damage and/or cost incurred by the IIIT, SRICITY the decision of the
Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator. And
.....by for and on behalf of the IIIT, SRICITY on the day, month and year first above
written.

Signed sealed and delivered by OBLIGATOR in the presence of:

1

2 SIGNED FOR AND ON BEHALF OF-----BY
..... in the present of:

GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR ANTI TERMITE TREATMENT.

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One Hundred Only)

The agreement made this day of two thousand and between___ S/o (hereinafter called the GUARANTOR of the one part) and the ----- (hereinafter called the IIIT, SRICITY of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) date and made between the GUARANTOR OF THE ONE PART AND the IIIT, SRICITY of the other part, **whereby the contractor, undertook to render the building and structures in the said contract** recited completely Anti Termite proof.

AND WHEREAS GUARANTOR hereby guarantee that the effect that the building and structures will remain completely Anti Termite proof for TEN years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract

NOW THE GUARANTOR hereby guarantees that Anti Termite treatment given by him under agreement Item No....., will render the structure completely Anti Termite proof and the minimum life of such Anti Termite treatment given by him will render the structures completely leak proof and the minimum life of such Anti Termite treatment shall be TEN years, to be reckoned from the date of completion of work.

Provided that THE GUARANTOR shall be not responsible for leakage caused by earthquake or structural defects or misuse of Building or alteration and for such purpose:

- a. misuse of Building shall mean any operation which will Anti Termite treatment to the building.
- b. Alteration shall mean construction of any addition or construction adjoining to existing Building whereby Anti Termite treatment is removed/damaged in parts.
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the Anti Termite proof treatment of the building to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the IIIT, SRICITY by some other contractor at the GUARANTORS cost and risk The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the Anti Termite treatment, or commits breach there-under then the **guarantor will indemnify the principal and his successor against all loss, damage, cost of expenses or** otherwise, which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement:

As to the amount of loss and/or cost incurred by the IIIT, SRICITY on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator__ and by __by
for and on behalf of-----on the day, month and year first above
written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF -----By__-'In presence of:

1. 2.

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR FOR WATER
PROOFING TREATMENT FOR ROOF**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One Hundred Only))

The agreement made this day of two thousand and between____ S/o (hereinafter called the GUARANTOR of the one part) and the -----(hereinafter called the IIIT, SRICITY of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) dated__ and made between the GUARANTOR OF THE ONE PART AND the IIIT, SRICITY of the other part, whereby the contractor interalia, undertook to render the building and structures in the said contract recited completely water and leak proof.

AND WHEREAS GUARANTOR hereby guarantee that the effect that the building and structures will remain completely water and leak proof for TEN years, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him under agreement Item No..... , will render the structure completely leak proof and the minimum life of such water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be TEN years, to be reckoned from the date of completion of work.

Provided that THE GUARANTOR shall be not responsible for leakage caused by earthquake or structural defects or misuse of Roof or alteration and for such purpose:

- a. Misuse of roof shall mean any operation which will damage proofing treatment like chopping of firewood and things of the same nature which might cause damage to the roof of the building.
- b. Alteration shall mean construction of any additional storey or part of the roof or construction adjoining to existing roof whereby proofing treatment is removed in parts.
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the building waterproof to the satisfaction of the Engineer at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the IIIT, SRICITY by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing. or commits breach there-under then the guarantor **will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which** may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement As to the amount of loss and/or cost incurred by the IIIT, SRICITY on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator__ and by__
for and on behalf of-----on the day, month and year first above
written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF -----By ____-'In presence of:

1. 2.._____

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR IN RESPECT
OF ALUMINIUM WORKS**

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One Hundred Only)

The agreement made this day of two thousand and between____ S/o (hereinafter called the GUARANTOR of the one part) and the -----(hereinafter called the IIIT, SRICITY of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) date~and made between the GUARANTOR OF THE ONE PART AND the IIIT, SRICITY of the other part,

whereby the contractor interalia, undertook to render the Aluminum Works in the said contract recited safe

against water leakage, unsound material and workmanship and defective anodizing etc..

AND Whereas GUARANTOR agreed to give a guarantee to the effect that the Aluminum Work will remain **safe against water leakage, unsound material and workmanship and defective anodizing for TEN years from** the date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.

NOW THE GUARANTOR hereby guarantees that the Aluminum Works executed by him will remain safe against water leakage, unsound material and workmanship and defective anodizing for TWO years from the **date of completion of work, to be reckoned from the date after the expiry of maintenance period prescribed in the contract.**

- a misuse of the Aluminum Work shall mean any operation which will damage the Aluminum Work** executed by him;
- b. Alteration shall mean construction of an addition to the Aluminum Work executed by him or part** thereof or construction adjoining to the existing Aluminum Work whereby the Aluminum Work is likely to be effected/ damaged;
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

Provided that the guarantor shall not be responsible for any damage caused by earthquake or misuse of the Aluminium Work or alteration and for such purpose:

During this period of guarantee the guarantor shall make good all defects and in case of any defect being found to render the Aluminium Work to the satisfaction of the Engineer at his cost and shall commence the

work for rectification within seven days from the date of issue of the notice from the Engineer calling upon

him to rectify the defects failing which the work shall be got done by the IIIT, SRICITY by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the water proofing, or commits breach there-under then the guarantor

will indemnify the Principal and his successor against all loss, damage, cost of expenses or

otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or cost incurred by the IIIT, SRICITY on the decision of the Engineer in charge will be final and binding on the parties.

IN WITNESS WHEREOF those presents have been executed by the obligator_ and by ___ by for and on behalf of-----on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF -----By___-'In presence of: 1 2

**GUARANTEE BOND TO BE EXECUTED BY THE CONTRACTOR IN RESPECT
OF**

STRUCTURAL GLAZING/ CURTAIN WALLSYSTEM/WORKS.

(On a Non- Judicial Stamp Paper of Rs. 100/- (Rupees One Hundred Only)

The agreement made this day of two thousand and between____ S/o (hereinafter called the GUARANTOR of the one part) and the -----(hereinafter called the IIIT, SRICITY of the other part).

WHEREAS this agreement is supplementary to a contract (Herein after called the Contract) date ----and made between the GUARANTOR OF THE ONE PART AND the IIIT, SRICITY of the other part, whereby the contractor interalia, undertook to render the Structural Glazing / Curtain Wall System/ work **under agreement Item No safe against water leakage, unsound material and workmanship and defective anodizing etc-.**

AND Whereas GUARANTOR agreed to give a guarantee to the effect that the Structural Glazing Curtain Wall System/Work will remain safe against water leakage, unsound material and workmanship and defective anodizing for FIVE years from the date of completion of work, to be reckoned from the date after the expiry **of maintenance period prescribed in the contract.**

NOW THE GUARANTOR hereby guarantees that the Structural Glazing/ Curtain Wall System /Work executed by him will remain safe against water leakage, unsound material and workmanship and defective anodizing for FIVE years from the date of completion of work, to be reckoned from the date after the expiry **of maintenance period prescribed in the contract.**

Provided that the guarantor shall not be responsible for any damage caused by earthquake or misuse of the Structural / Curtain Wall System/ Work or alteration and for such purpose:

- a. misuse of the Structural Glazing / Curtain Wall System / Work shall mean any operation which will damage the Structural Glazing/ Curtain Wall System/ Work executed by him.
- b. Alteration shall mean construction of an addition to the Structural Glazing I Curtain Wall System Work executed by him or part thereof or construction adjoining to the existing Structural Glazing / Curtain Wall System I Work whereby the Structural Glazing I Curtain Wall System/Work is likely to be affected/ damaged.
- c. The decision of the Engineer with regard to nature and cause of defects shall be final.

During this period of guarantee, the guarantor shall make good all defects and in case of any defect being found to render the Structural Glazing / Curtain Wall System /Work to the satisfaction of the Engineer-in-Charge at his cost and shall commence the work for rectification within seven days from the date of issue of the notice from the Engineer calling upon him to rectify the defects failing which the work shall be got done by the IIIT, SRICITY by some other contractor at the GUARANTORS cost and risk. The decision of the Engineer as to cost, payable by the Guarantor shall be final and binding.

That if Guarantor fails to rectify the Structural Glazing/ Curtain Wall System/ work or commits breach there under then the Guarantor will indemnify the Principal and his successors against all loss, damage, cost, expense or otherwise which may be incurred by him by reason of any default on the part of the Guarantor in performance and observance of the supplementary agreement. As to the amount of loss and/ or damage *and/or* cost incurred by IIIT, SRICITY, the decision of Engineer will be final and binding on the

parties.

IN WITNESS WHEREOF those presents have been executed by the obligator__ and by __ for and on behalf of-----on the day, month and year first above written.

Signed sealed and delivered by OBLIGATOR in presence of:

1. 2.

SIGNED FOR AND ON BEHALF OF -----By__-'In presence of:

1. 2.._____

PREAMBLE TO SCHEDULE OF QUANTITIES

GENERAL

The conditions of contract and the drawings shall be read in conjunction with the specifications and matters referred to, shown or described in one are not necessarily repeated in the other. These specifications are comprehensive but may exceed the requirements of this project. Any ambiguity between the General Specifications, the Bill of Quantities and contract drawings, shall be referred to the Engineer-In-Charge for clarification not later than 10 days before the date fixed for delivery of Tenders. Any ambiguity may be referred to the Engineer-In-Charge after signing the contract and Engineer-In-Charge shall give a ruling which shall prevail. No claim for additional cost due to above, however, will be entertained.

Notwithstanding the sub-division of the specification into various headings, every part of it is to be deemed supplementary to every other part and is to be read with it, so far as it may be practicable so to do, or when the context so admits.

In this contract, reference is made to the Indian Standards or CPWD specification as approved by Engineer-In-Charge and these references shall be deemed to include the latest editions or issue of standards, specifications or By-Law including all revisions upto the date of invitation of Tenders. The contractor shall ensure that all materials and workmanship in so far as they apply to this contract shall comply in every specification or any other equivalent or specification approved by the Engineer-In-Charge.

The Contractor shall keep at site copies of all relevant standards and codes of practice referred in these specifications throughout the period of contract. These shall be the latest editions and shall include all revisions/ addendums thereof.

Approved Manufacturers: Names of approved manufacturers are given in the specifications. Reference in the specifications to approved manufacturers shall be construed as establishing a standard of quality and not as limiting competition.

The Contractor shall include in his prices for supplying the item or materials from the approved manufacturers listed or equal and approved.

All items or materials shall be delivered to the site in the manufacturers' original unopened containers with the manufacturers brand and name clearly marked on.

All items or materials shall be assembled, mixed, fixed, applied or otherwise incorporated in the works in accordance with the printed instructions of the manufacturer of the item or materials.

Date of construction to be written on all respective items for monitoring curing.

The contractor shall follow the pour card/check list for all the concrete/finishing items on prescribed formats.

SITE DEVELOPMENT AND EARTH WORK

The rate of items in this section also to include:

1. Measurement of excavation for payment shall be recorded only for the plan dimensions of the +400mm from bedding concrete (PCC under foundation) provided in the structure drawings. Excavation for working space and slopes for soil stability shall not be measured and paid.
2. During the excavation if required Contractor has to arrange & run deterring Bore to maintain site water table below 1 mtr from deepest foundation level including casing, perforated pipes, soil filter, Submersible pumps, connecting wire, including all tools and tackles, connecting the discharge pipe to nearest drain from site premises. The contractor must ensure all safety and ensure backup pumps in case of any breakdown. The complete system is to be installed as per the engineer's satisfaction. Cost is inclusive of Providing and running Diesel Generator (1 Running/ 1 Standby) with required fuel. The contractor has to arrange & maintain a temporary drainage system till completion of dewatering. No extra amount shall be claimed by the contractor on this account and his quoted rates shall be deemed to include dewatering if required. The Contractor to make his assessment for the same.

3. During the excavation if required Contractor has to arrange & shoring with suitable method. Contractors should give their proposal for method of shoring & get approved from the Engineer-in-charge/ Architect before commencement of excavation at site.
4. Stacking of excavated earth within the site including handling.
5. Site clearance such as clearing of shrubs, brushwood, undergrowth, roots and small trees not exceeding 30cm in girth measured at 1m above ground.
6. Setting out the work, profiles, benchmarks etc.
7. Excavation either straight or curved in plan or to any desired shape or slope.
8. Provision of adequate barriers, Signage's, lighting, and gangways across excavated area open trenches etc. for protection of workmen and public.
9. Getting out and throwing spoil clear of area being excavated or disposing clear of edge of excavation to avoid falling in, as directed by the Engineer-In-Charge.
10. Trimming all sides, plumb and square, levelling all bottoms, clearing out loose earth, slips and falls from excavations before concreting.
11. Work at all depths and locations, unless otherwise specified.
12. Bailing, pumping out or removing all water which may accumulate in the excavation from all causes.
13. Necessary shoring, strutting, battening, benching. Contractor to submit methodology & design.
14. Signing guarantee Proforma for anti-termite treatment i.e., satisfactory performance for a minimum of 10 years from the date of final completion of project on an approved proforma. The guarantee shall be executed and extended by the Contractor and not by the anti-termite agency.
15. Conducting laboratory or field test for soil compaction.
16. Compacted volume of earth shall be measured for payment at true location of filling.
17. All excavated material shall be the property of the owner or otherwise as specified in the items.
18. Excavation and disposal of the basement shall be done by mechanical means and equipment.
19. Manual dressing to achieve the final level as directed by structural engineer.
20. Royalty & other taxes payable.
21. Dismantling & disposal of any structure / construction in excavation area.
22. Compliance with all stipulations of technical specification.

CONCRETE WORKS (PLAIN AND RCC)

The rates for all items under this section also to include:

1. Generally, all concrete work shall be as per IS-456 (latest edition) characteristic strength (28 days) shall be 20 N/sq. mm, 25 N/Sq mm, 30 N/Sq mm and 35N/sqmm as may be specified on drawings. The rate of all items to include for mix designs for various strengths and workability and routine cube testing at various stages for strength as required. The cost of concrete admixtures is included in the quoted rates, the use of which shall be approved by the Engineer- In-Charge. The rates shall include providing all materials, mixing, placing, compacting, cutting, finishing, placing inserts, holding down bolts and flanges, sleeves, puddle flanges, embedding all services pipes, boxes, hooks etc. as shown in drawings at correct location level with required changes in form work, reinforcement etc., complete. All RCC works and all concrete shall be machine vibrated. Formwork and reinforcement are measured separately. All concrete shall be with 20mm and downgraded nominal size stone aggregates except specified otherwise. Curing of the concrete shall be

as per IS-456 (Latest Edition). All RCC work will be measured and paid as laid, quantity for both the cases by using RMC or by using cast in situ concrete with batching plant. No payment will be made according to the supply quantity.

2. The rate of reinforcement work shall include for handling/ storing clearing of rust, straightening, bending and placing, binding, fixing in proper position at any height/level with 18 gauge annealed binding wires, necessary chairs, spacer bars, wastage and cement mortar cover blocks at proper positions to maintain proper cover as per IS-456 (Latest Edition). Reinforcement shall be bent in accordance with IS-2502.
3. Inverted cantilever, Circular / Curved, offsets, Projection, fins, bands, nibs and sloping members on slab, beams, columns, staircase including drilling, cutting, bonding agent complete to the satisfaction of Engineer-In-Charge etc.
4. Holes and openings in RCC slab/walls, parapet, masonry works, pockets in machine foundation, beam, parapets, for rainwater pipe or spouts and plumbing pipes shall be left at the time of concrete casting or raising masonry and making good after fixing fixtures.
5. If in the opinion of the Engineer-In-Charge, any surface other than specified for obtaining patterns in exposed surface in concrete under specific items, is asked to be left unrendered and painted, then the item will not be measured as an item concerning exposed surface and no extra for any reason will be allowed.
6. Jointing new work with the existing concrete/brickwork including shuttering and approved bonding agent for construction joints.
7. Reinforcement shall be paid separately by weight placed in position as per the bar bending schedule, to be prepared by the contractor and approved by the Engineer-in-charge. The weight shall be taken as per IS Code for the particular diameter. Rates quoted for reinforcement shall include for cutting, bending, binding the reinforcement bars in any shape, hoisting to all leads and lifts and placing in any position as per detailed drawings, including providing precast cement concrete cover blocks of required thickness for keeping bars in position. 18 gauge annealed binding wire for tying for reinforcement shall be provided by the contractor. The contractor should cover for this in his overall rate for the reinforcement rates including removing rust, Mill scales, oil, grease, paint etc. from reinforcing bars.
8. Generally, in items for form work rate to include form work, centering, shuttering, boxing propping including special nuts, bolts etc. in perfect line, level, plumb and if required to provide camber, slope and removal thereof. Colorless shuttering oil or grease of approved quality shall be applied to forms before placing steel. Rate to include for any shapes including offsets/ chamfering in columns, residues, grooves, drip moulds, irregular shapes etc. Measurement shall be in sqm regardless of shape, size and thickness of members. Stripping time for the formwork, centering and dropping shall be as per IS-456 (Latest Edition).
9. Work at all heights, depths & levels irrespective of individual storey.
10. Work in narrow widths, Piece meal/ small work, screeding under floor etc.
11. All staging up to any height and scaffolding work shall comprise of MS Pipes/ Structural steel sections with necessary coupling arrangement. (NO WOODEN BALLIES / PROPS WILL BE PERMITTED). Adequate size foundation blocks / base plates shall be provided below staging members to disperse the loads as per the founding strata.

12. Contractor shall set up on site concrete pump, hoists, tower cranes, passenger elevator, automatic microchips controlled Batching plant of capacity 10 cum per hour or more complete with silos/ stockpiles for cement and aggregates, and also a D.G. set to be provided for uninterrupted supply of concrete. Use of batching plants for all concrete work is mandatory.
13. Providing grooves, drip molds, molds, chamfers, curved surfaces, and ornamental works in RCC members as per drawing and finishing to specified shape.
14. Forming all expansion and / or construction joints as directed.
15. Contractor to consider in his quoted rates the necessary arrangement e.g. providing and fixing of required quantity of woven mesh at the junction of Beam and Column or any other RCC members to separate two different grades of concrete mixes. No payment shall be made for over flowed richer mix of one RCC member into the other.
16. Use of greater than minimum specified quantities of cement to achieve specified or required mix design.
17. Use of plasticizer / super plasticizers (approved by Engineer-In-Charge) and / or additional cement for pumpable concrete.
18. Non-destructive test for defective concrete as directed by Engineer-In-Charge, and their remedial measures thereof.
19. Leaving dowels for anchorage of brickwork and other RCC members.
20. Mix designing and testing all the ingredients of concrete from approved laboratory for each grade, pumpable & non-pumpable concrete.
21. Compliance with all requirements of technical specification.

MASONRY WORKS:**The rates for all items under this section also to include:**

1. All scaffolding, platforms, ladders, staging and plant required in the execution of work to any height or depth and lift.
2. Hacking and roughening of concrete or other surfaces in contact with masonry for bondage.
3. Leaving out dowels from concrete members for anchorage.
4. Labour provides in beam bed blocks of concrete.
5. Rough cutting and waste.
6. Levelling up and preparing tops of walls for damp proof courses, plinth beams, precast units etc.
7. Raking out joints to specified depths either for plaster or pointing or finishing the joints flush as the work proceeds, as directed.
8. Bedding and pointing wall planes, cills, lintels etc. in or on walls, bedding and pointing drops, window and structures in cement mortar.
9. Forming chases for edges of concrete floors or other units, for sealing in or other waterproofing layers etc.
10. Holes (cut and formed or left), for fixing pipes, bolts and other inserts and making good including grouting if necessary.
11. Building in holdfasts and such other inserts.
12. Work in steps, pillars (round and square) and also in circular work.
13. Keeping the work well wet for ten days.

14. Work at all heights, depths and locations, unless otherwise mentioned.
15. Work in parts / joining old / new work including, toothing applying cement slurry etc complete.
16. Washing and cleaning of brick surface with such chemicals as are deemed necessary by the Engineer-In-Charge for any efflorescence observed in the brick work.
17. Opening for exhaust fans/ rainwater pipes/ spouts etc as shown in drawing and/ or as directed at site. No reduction for such an opening shall be made.
18. Layout and layout course with flat brick/brick on edge / string course wherever required.
19. Any efflorescence observed in Brick Work should be watched on with clean water and treated with such chemicals as are deemed necessary by Engineer-In-Charge. The Brick Work shall be dismantled if deemed necessary by Engineer-In-Charge and rebuilt with new bricks including making good all disturbed and damaged work.
20. Providing & laying of Hoop Iron as per specifications.
21. Rate to include for any shapes, fins, projections, shafts, Work in narrow widths, Piece meal/ small work etc. Piece meal work necessitated by coordination & requiring of work of other agencies.
22. Compliance with requirements of technical specification.

WATER PROOFING:

Waterproofing work shall be carried out by the specialized agency as approved by Architect/ Engineer-In-Charge.

The rate of all relevant items of waterproofing covered under this section to include:

1. Cleaning, smooth rendering and preparation of surface for lying waterproofing, insulation and other treatments.
2. All cutting, trimming, dressing and waste.
3. Treatment of down take pipes, and other obstructions as shown.
4. Providing 50x50, size chase in wall, parapets etc. at 300mm height from floor finish level for tucking ends of vertical layers of the treatment, filling up the chase with cement mortar 1:4 and preparing a drip mold as per detailed drawing just above the chase.
5. Sealing all joints, corners, junctions of pipes and masonry/ concrete with epoxy putty.
6. Curing/ wetting the surface for at least for 10days and gunny bags to be spread wherever required before application of subsequent coat.
7. Work in narrow widths, junctions and at all locations as shown.
8. Work at all heights and depths.
9. 72 hours Pond testing of treated areas to the satisfaction of Engineer-In-Charge.
10. Signing guarantee as per approved Performa for waterproofing treatment for 10 years from the date of final completion on non-judicial stamp paper. The guarantee shall be executed & extended by the contractor and not by the water proofing agency.
11. Hydro testing for underground and overhead water tanks. The contractor shall get water tanks tested against any leakage by filling the tanks with water and maintaining it for seven days up to free board including cost of water, all necessary arrangements required for filling and emptying the tank after testing.
12. Compliance with requirements of technical specification.
13. Mode of Measurements.

a) Terrace

All measurements will be for roof area only as measured on plan and no additional area for vertical tucking/embedding up to 300mm right from top of finish, providing and making Gola, khurrah wherever required shall not be paid extra. The contractor rate will be inclusive of all this to make the work complete.

b) Toilet Areas

Floor: Area of the toilet area shall be measured by length x breadth between walls. Vertical side. The actual area treated shall be measured by length x height.

c) Injection Treatment

Floor: The total area of raft/ floor including the area below walls and projections and projections of treatment, if any shall be measured.

d) Walls:

Actual area treated shall be measured.

FLOORING WORKS:

The rates for all items under this section also to include:

1. Use and waste of all temporary fillets, side forms, templates, moulds, straight edges etc.
2. Final preparation of the base, sub-grade or sub-floor including trimming of the base to remove all undulations including chipping or filling with concrete/ cement mortar, if necessary.
3. Cleaning and watering the surface immediately before laying on the floor.
4. Providing a bedding layer of mortar as specified, in the case of slabs, tiles etc. to correct levels and slopes as called for.
5. Curing, protecting and cleaning all surfaces as specified.
6. Leaving or chasing recess for skirting to match with plaster surface, bends, steps etc. on walls/ concrete and making them good after finishing of the wall.
7. Payment shall be made only for the finished dimension actually measured at site of work.
8. No work shall be started until the concealed piping drains etc. are laid by other agencies. Prior to commencing any finishing surfaces, levels and the slopes to drains shall be approved, in writing by the Engineer-in-charge. Further to do so may result in demolishing the finished surface and redoing the work, all at contractor's expenses.
9. Laying floors to required slope in any size and shape of panels, pattern & design of panels. The strips shall not be paid for separately.
10. Work shall be carried out at all heights, levels, leads and lifts.
11. Use of all scaffolding and cradles, dust seats and other coverings for fittings, furniture, floors etc. (for all heights and locations).
12. Compliance with requirements of technical specification.

FINISHING WORKS:

The rates for all items under this section also to include:

1. Making all construction and expansion joints, curving, curing.
2. Making grooves of any pattern as per drawings or as directed by the Engineer-in-charge in plaster and dados including rounding of junctions with floors.
3. In case of wall plaster, dado and skirting, raking out joints, cleaning the surfaces, application of cement slurry, applying plaster, skirting and dado treatment unless otherwise specified.
4. Work on patches, narrow widths, small quantities, curved surfaces, projected/ resets bands, setbacks, offsets, corbels, architraves etc.
5. Extra thickness of plaster over indentations etc.
6. Repairing and finishing the junctions of skirting and dado, with relevant mortar/finish.
7. Finishing the chases, edges of electrical fittings and boxes etc.
8. Use of all scaffolding and cradles, dustsheets and other coverings for the protection of fixtures, fittings, furniture, floors etc. (for all heights and locations).
9. Grooves, bands in plaster, on RCC bands, drip coarse etc. in plaster works as per

directions.

10. Cleaning of paint splashes, drops or dirt, glasses, joinery, electric fittings etc., including washing the floor and leaving the premises neat and clean.
11. Work shall be carried out at any elevations, all heights, levels, leads, lifts.
12. Cutting line of two different finishes should be in straight line or as shown in drawing, bands wherever required.
13. Providing and fixing 300mm wide chicken wire mesh with GI screw and washers at the junctions of two different materials and on all chasing for electrical & plumbing conduits, pipes etc.
14. Cost of waterproofing compound wherever mentioned in Bill of Quantities.
15. Compliance with requirements of technical specification.

MISCELLANEOUS WORKS:

The rates for all items under this section also to include:

1. Steel forging, reducing to required shape, size and figure, drilling, tapping, counter sinking for screws, filling etc. and satisfactory workmanship required to fabricate, finish, erect and fix in position, all structural steel and iron in a good and perfect manner.
2. Providing all bolts and nuts including holding down and anchor bolts, round, squared or tapered washers, anchor plates, rivets, packing pieces, gusset plates, cleats, wedges, brackets, separators etc. (net weight to be computed and paid).
3. All wastage and cut pieces.
4. Welding as per specifications and drawings but weight of welds not to be paid.
5. Weight of various members to be taken as standard ISI weights. No allowances being made for rolling margins in steelwork.
6. Providing all spikes, nails, service bolts, clamps, jigs etc.
7. Making all necessary templates, patterns, mould and platforms for layout etc.
8. All smithy work, unloading, getting in, hoisting, erecting and fixing in position at all heights, levels and locations, curve portion.
9. Rigidly inserting and setting in lead or other specified material and fixing into concrete and / or building into brick work while the work proceeds and for all fixing, anchoring, plugging, screwing, bolting etc. including non-shrink grout and sealants as may be required or directed.
10. Painting two topcoats of red oxide primer before hoisting and erecting in position.
11. The priming coat is required to be of high-grade loosing approved quality of Red Oxide primer to provide a coating having a good rust preventive property and adhere well to the metal surfaces, affording a good foundation for subsequent coats.
12. Bending to required shape of square bars, pipes, angles, plates etc. as per drawing.
13. Compliance with requirements of technical specification.

..... **END OF CIVIL TECHNICAL SPECIFICATION**.....

Technical Specifications for Pre-Engineering Building Works

1. BRIEF SCOPE OF WORKS

Design, Engineering, Preparation of execution Drawings, Supply, Transportation & Execution of Pre-engineered Building Steel Structural Works as follows:

- Pre-engineered Steel Structures
- Roof sheeting works with 50mm thick Rockwool panel/ Puff panel of density 100 kg/ cum.
- Wall cladding Works above 3.45 Mts. Height (as per drawings)
- Cutout and sealing of cutout for ducts, fans, pipes, cables etc.
- Anchor bolts and templates

2. BUILDING DESCRIPTION FOR PRE-ENGINEERED BUILDING

BUILDING PARAMETERS				
1	Type of Frame		As per Drawing/ manufacturer’s specifications Ridge at middle.	
2	No. of interior columns		As per Drawing	
3	Width Module (m)		As per Drawing	
4	Roof Slope		1:10 / As per Drawing	
5	Roof Width (m)		36.55 m out to out / As per Drawing	
6	Roof Length (m)		55.94 m out to out / As per Drawing	
7	Exterior Columns Base Condition		As per Drawing cusp	
8	Interior Columns Base Condition		As per Drawing	
9	Height (M) from FFL		Clear: 10.25 m from floor (As per Drawing) Note Base plate shall be -300 mm below FFL or stiffeners to hide.	Eave
10	Bay spacing (m)		Drawings to be referred for correct dimensions.	
11		Left End wall	Frame type: As per design	Girts: As per Design.
			As per Drawing	
		Right End wall	Frame Type: As per design	Girts: As per Design
			As per Drawing	
12	Future Expansion		NA	
13	Bracing Type	In exterior side walls	As per Drawing	
		Between interior columns	Portal Bracing	

13	Type of Eave	Eaves gutter and valley gutter as per location with Circular downspouts with 3 mm FRP lining on gutter or as per manufacturer's specifications.
14	Type of Gable	Gable trim
15	Exterior Rigid Frame Columns	As per Design/ Drawing.
17	Lean To/ Canopy	As per Design/ Drawing.
18	Facia	NA
19	Fillet Weld of Built-up sections	As per Manufacturer's specifications
20	Minimum Built up section Thickness	As per Manufacturer's specifications
21	Minimum cold formed member thickness	As per Manufacturer's specifications

Building Description:

Roof Accessories		Quantity
No.	Description	
1	Roofing with Insulation. 50mm thick Sandwich panel (Puff panel/ Rockwool panel) of density 100kg/cum. In roofing with necessary accessories.	YES

Wall Accessories		Quantity
No.	Description	
1	Wall Sheeting: 0.5 mm Pre-Painted Galvalume Sheet (PPGL) Standing Seam with RAL 9002 (Off White Colour)	
2	Steel cage ladder Painted same as Primary steel	As per requirement.

Roof Panel	Profile	50mm thick Rockwool panels of 100kg density conform to IS: 14246 / ASTM A 792 Gr 80
	Material	GALVALUME
	Finish	BARE
Wall Panel	Profile	0.5 mm Pre-Painted Galvalume Sheet (PPGL) Standing Seam with RAL 9002 (Off White Colour)
	Material	GALVALUME
	Color	As per Selection

LIST OF DRAWINGS ATTACHED:

S No.	DRAWING TITLE	DRAWING NO.
1	Ground Floor Plan	IIITS/MSB/TD/AR-101
2	First Floor Plan	IIITS/MSB/TD/AR-102
3	Terrace Level Plan	IIITS/MSB/TD/AR-103
4	Top Level Plan	IIITS/MSB/TD/AR-104
5	Schedule of Finishes	IIITS/MSB/TD/AR-111
6	Elevations	IIITS/MSB/TD/AR-201
7	Sections (Sheet 01)	IIITS/MSB/TD/AR-301
8	Sections (Sheet 02)	IIITS/MSB/TD/AR-302

3. DESIGN & ENGINEERING:

The contractor would be the sole provider for Design, Engineering and Fabrication services for the entire pre-engineered building steel structural works & shall be responsible for getting necessary approvals.

The scope of work for the Design, Supply, and Execution for the pre-engineered structural steel works would be to provide the design criteria documents for these disciplines required to build this project as per the Indian Standard codes / conditions. The detailed scope of services would be as follows:

1. Complete structural analysis, design and preparation of all structural drawing and details for execution, as per requirement above plinth level.
2. Structural analysis, design and preparation of all structural drawing and details for execution, as per requirement for superstructure up to roof and secondary structures (columns, main beams, secondary framings, beam column connections, base plates, anchor etc.).
3. Structural analysis, design and preparation of all structural drawings of the column & roof truss members for lateral supports etc.
4. Preparation of all necessary details, drawings, designs (in STAAD Pro software for analysis in 3D model) and manual calculations for designs and getting the necessary approval of pre-engineered building from the Architect/ Consultant.
5. Preparation of necessary specifications, documentations, drawings for the entire Steel works.
6. Preparation and submission of design calculation for approval which includes load calculation, detailed analysis of structure and design of structure as per codal requirement including deflection limitations. Contractor shall submit three sets of design calculations along with drawing for comments/ approval and shall incorporate all comments and shall submit final documents after incorporation of comments.
7. Documents must be furnished in English language, two sets of preliminary sketches, two sets for final approval and six sets of documents (hard copies as well as soft copies) for calculation, analysis, reports, tender/ purchase documents, specifications, bill of quantities for each work/ system after final approval.

8. Preparation of PERT network for the complete project indicating all activities, critical paths, restraints etc. and updating of network as and when required by the contractor (and as approved by the Client) along with budgeted project cost and monitoring project cost.
9. The contractor is also required to submit the following on completion of the project:
 - i. Two complete sets of all original print as well as soft copies of structural & other drawings in English language.
 - ii. Two sets of hard copies as well as soft copies of design calculation of all structural drawings in English language.
10. **Design Loads**

10.1 Dead Load (DL):

These are permanent loads due to self-weight of steel members, platform floor, etc.

10.2 Live load (LL) on roof for rafter design: 75 kg/sqm (Live load as per IS 875) & Additional Load of 30 kg/sqm for Solar panel.

10.3 Wind Loads (WL): as per IS 875 Part 3

Following data shall be considered for wind load calculation:

Basic wind speed = 50 m/sec ($K_1=1.0$ & K_2 =for terrain cat II) or as per manufacturer's specifications.

10.4 Seismic Zone:

Structural Design to be done as per Seismic Zone-III

11. Requirements & Standards:

- i. The building is to be constructed that the combined dead, imposed and wind loads are safely transmitted to the ground without deformation and deflection of any part of the building.
- ii. Structures shall be designed in accordance with IS and AS codes requirements.
12. **The following are minimum requirements for structural steel work:**
 - a. Minimum thickness of material for main & secondary structural members shall be 6mm & 4.5mm respectively (thickness may increase/ decrease as per loading & design. Relevant IS and AS code shall be followed for checking the thickness of members). Painting shall be Two coat of anti-corrosive primer followed by two or more coats Fire retardant paint.
 - b. Deflection criteria

Purlin and side runner-	span/150
Rafter-	span/180
Horizontal deflection-	Height/100
 - c. Built up section welding on both sides.

4. STRUCTURAL STEEL WORKS AND SHEETING

4.1 STRUCTURAL STEEL WORKS – GENERAL

1. Guarantee against Safety for Structural Design:

The supplier shall provide guarantee against safety of the structural design with

indemnity bond for the period of minimum 10 years. (Total Guarantee Period for the structure to be specified in Annexure B)

2. Detailed Shop Drawings:

All detailed shop drawings shall be submitted for approval before commencing fabrication works.

3. Structural Steel Works:

Steel Structure and roof and wall cladding will be supplied and erected by the contractor.

Necessary space for unloading and stacking shall be provided. Program of erection shall be indicated in contractor's proposal.

4. Structural Steel Works – General Specifications:

- a. All steel members for roof rafters, columns, bracings, gantry girders etc. shall be **Pre – engineered** steel structure.
- b. The roof shall have a slope of 1:10 so that there is no leakage from the shed.
- c. The structure shall be designed and fabricated as per Indian Standard codes and subject to the client's requirements & approval.
- d. The structures shall be fabricated as per the shop drawings based on approved drawings by the client.
- e. All purlins shall be galvanized cold rolled Z-purlins. Purlins shall conform to the loading with desired thickness & width/ depth.
- f. Sag rods shall be 16 mm dia. minimum or as per the Indian Standard codes requirement.
- g. All Columns shall be considered as hinged connection.

5. Tolerances for Steel Structures:

(a) Columns

-	Deviation of column axes at foundation top level with respect to true axes.	
i)	In longitudinal direction	+5mm
ii)	In lateral direction	+5mm
-	Deviation in level of bearing surface of columns	+5mm
i)	At foundation top with respect to true level	+5mm
-	Out of plumb (verticality) of column axis from true vertical axis, as measured at top:	
i)	Up to and including 30m height	+H/1000 or +25mm whichever is less
-	Deviation in straightness in longitudinal & transverse planes of column at any point along the height	+H/1000 or +10mm whichever is less
-	Difference in the erected positions of adjacent pairs of columns along length or across width of building prior to connecting trusses/beams with respect to true distance	+5mm
-	Deviation in any bearing or seating level with respect to true level	+5mm
-	Deviation in difference in bearing levels of a member on adjacent pair of columns both across & along the building	+5mm

(b) Trusses/Rafters

- | | |
|--|--|
| - Shift at the center of span of top Chord member with respect to the Vertical plane passing through the Center of bottom chord. | +1/250 of height of truss in mm at center of span or +15mm whichever is less |
| - Lateral shift in location of truss from its true position. | +10mm |
| - Lateral shift in location of purlins from true position | +5mm |

Construction of all other items of works shall conform to relevant codes and Standards and sound engineering practices. Steel Contractor shall be responsible for the complete safety pertaining to all construction works.

4.2 STRUCTURAL STEEL WORKS - ANCHOR BOLTS / GROUTING**1) Anchor Bolts:**

The structural steel contractor shall supply anchor bolts as per Design. However, placing of anchor bolts in the position is excluded from the scope of work. Anchor bolts shall be placed in position by other agency and the contractor shall coordinate with that agency to ensure that they are provided as per requirement to avoid any mismatch at the time of erection.

2) Base Grouting:**Column Bases**

Type of Grouting: Non-shrink cement based grout

Grout Thickness: Minimum 50 mm thick

Grout Strength: 40 N/Sqmm or as per manufacturer's specifications

All grouts shall flow freely and occupy each and every corner of the plates. There shall not be any hollow pockets.

4.3 STRUCTURAL STEEL WORKS - SHEETING / CLADDING WORKS**a. Roof:**

50mm thick Rockwool Panel of density 100kg/cum.

b. Wall Cladding Sheets:

0.5 mm Pre-Painted Galvalume Sheet (PPGL) Standing Seam with RAL 9002 (Off White Colour) to be fixed using SDST screws with polymer cap complete as per specifications or as per manufacturer's specifications.

c. Gutters:

Gutter to be designed for maximum rainfall drainage from roof & gutter to have minimum 3mm thick FRP coating with UV coating as per Indian Standard Code complete as per specifications. Minimum size of gutter shall be specified by the vendor.

d. Down take pipes:

Down take pipes of color coated steel to be designed for complete drainage of roof and intermediate down take pipes at required interval. Minimum size of pipes shall be specified by the vendor.

4.4 STRUCTURAL STEEL WORKS – MISCELLANEOUS

a. Miscellaneous Structural Items:

All necessary flashing, corners, trims, etc., shall be provided in approved color and shall be pre-coated steel sheets and making provisions of brackets for hanging pipe rack, cable tray, ducting etc.

b. In general followings should be followed:

All members shall have double side welding. Minimum size of structural weld and splice detail shall be as per Indian Standard codes provided with butt welding and additional cover plates for 40 % of strength unless 10 % welds are radiography tested.

Only spring washers shall be used for all connections.

5. PAINTING SPECIFICATIONS

Steel Surface Finish: Well prepared, cleaned with wire brush

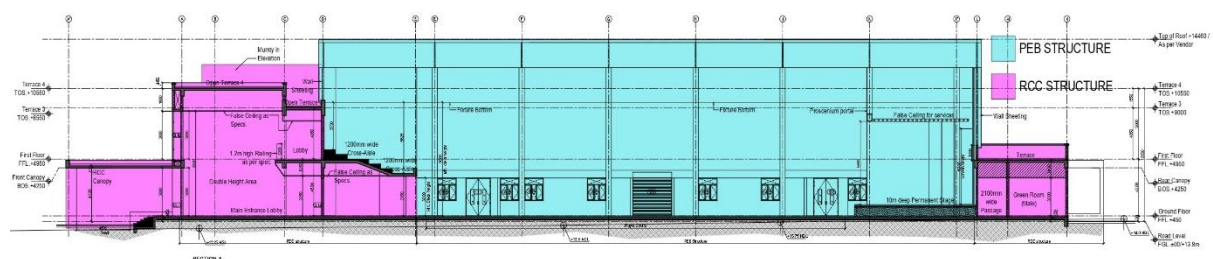
Type of Paint: Two coat of anti-corrosive primer followed by minimum 2 coat of Fire-retardant paint (of approved quality)

Total Dry Film Thickness: 120 micron (all inclusive) or as per manufacturer's specifications.

Colors: Subject to Client's approval.

All the structural steel work shall be finished with minimum 2 coats of Fire-retardant paint. The total dry film thickness shall be 120 microns on well prepared, cleaned surface to Client's approval.

Paint system considered for the structural steel shall be Fire retardant, 120 microns DFT, achieved in two/ three coats.



Indicative reference showing RCC & PEB extents in building Section.

ANNEXURE-I
TECHNICAL DATA SHEET (TO BE FILLED BY BIDDER)

Sl.	Description	Suggestive
1	Area (Approximate)	
a	Plan Area	
b	Roof Area	
2	Frame Type	
3	Width (m)	
4	Length (m)	
5	Clear Height (m) From FFL	
6	Width Module (m)	
7	Slope	
8	Bay Spacing (m)	
9	Type of End Frames	
10	End Wall Column Spacing (m)	
11	Bracings Type	
12	Primary Member	
13	Secondary Member	
14	Openings at front side wall	
15	Openings at back side wall	
16	Openings at left end wall	
17	Openings at Right end wall	
18	T.1 Design Loads:	
a	Plan Area	
b	Live load	
c	Wind Speed	
d	Seismic Zone & Coefficient	
e	Collateral load	
f	Cable Tray Load / Pipeline Load (Water Pipeline, Steam pipeline, Air Pipeline etc.)	
g	Solar Panel Load	
19	T.2 Deflection:	
a	Horizontal	
b	Vertical-Main Bldg.	
c	Roof Purlin (LL)	
d	Roof Purlin or Wall girt (WL)	
20	T.4 Roof System	
a	Roof Cladding	
b	Profile	
c	Thickness Of Panel and Sheet (TCT)	

d	Material of Construction	
e	Roof liner panel	
f	Eave Gutter / Eave trim / Valley Gutter	
	T.5 Wall System	
a	Wall Cladding	
b	Profile	
c	Thickness	
d	Material Of Construction	
e	Downspouts	
f	Wall Height	
	T.6.2 Cage Ladder	
	Size	
	Quantity	
	Location	
	T.6.3 Framed Openings.	
	Location	
	Qty	
	Size	
	T.6.4 Canopies	
	Location	
	Nos.	
	Projection	
	Length	
	Clear Height	
	Soffit	
	T.7 Material Specification	
	Built Up Members	
	Hot - rolled member	
	Hold formed secondary members	
	Galvanized cold rolled Z-purlins	
	X-bracing members	
	Roof & Wall Cladding	
	Members fabricated from plate or bar stock shall have flanges and web joined by continuous welding process	
	High-strength bolts for primary connections	
	Machine bolts for secondary connections	
	Self-drilling screws	
	Any other Miscellaneous	
21	T.8 Total Qty. of MS Steel to be used for PEB in Kg.	

ANNEXURE II**WORKING SCHEDULE (TO BE FILLED BY THE BIDDER)**

Sl.	Deliverables	Scheduled Time After Award of work (Weeks)
1	Preparation of Shop Drawings & Submission	
2	Delivery for Anchor Bolt & Base plate	
3	Production/ Fabrication of structural members in factory	
4	Delivery of Structural Material at Site	
5	Execution & Erection of Structure	
6	Delivery of Sheeting material at site	
7	Installation Roof, Deck & Wall Sheeting at site	
8	Delivery of Roof Insulation & Polycarbonate sheet	
9	Installation of Roof Insulation & Polycarbonate sheet	
10	Final Completion of Work	
11	Rectification of Snags	
12	Handover of site	

ANNEXURE III**LIST OF MAKES PROPOSED BY BIDDER**

Sl.	Item Description	Approved Makes
1	Structural Steel	
2	MS pipes	
3	GI pipes	
4	PVC pipes	
5	Aluminium Sheets	
6	Galvalume Sheets	
7	Welding Electrodes	
8	Painting	
9	Insulation	
10	Rockwool panel	
11	Non-shrink grout	

..... **END OF PEB TECHNICAL SPECIFICATION**.....

TECHNICAL SPECIFICATION OF PLUMBING WORKS:

- 1. Technical Specification of DSR items of Public health works (Based on DSR 2023) mentioned in SOQ shall be as per CPWD specification 2019 VOLUME I AND VOLUME II (corrected up to the last date of submission/uploading of bid).**
- 2. For Nonscheduled item mentioned in SOQ shall be installed as per manufacturer's direction approved by the Engineer-in-Charge-in-charge.**
3. Specification/brands names of fixtures to be used as per the scope of work are listed in the bid documents. The efforts should be made by the Contractor to use indigenous products. The Contractor should also consider the availability of spares parts/ components for maintenance purposes while proposing any brand/ manufacturer. The materials of any other brand/manufacturer may be proposed for use by the Contractor in case the brands specified below are not available in the market and/or Contractor intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of Engineer-in-Charge-in-Charge. The list of approved makes is appended to this document.

TECHNICAL SPECIFICATIONS PLUMBING WORKS**1. BASIS OF DESIGN**

The Plumbing, Sanitary, Drainage System for the project is designed keeping in view the following:

- 1.1 Requirement of adequate and equal pressure availability of hot and cold water lines in Public Toilets and Washing Drying areas.
- 1.2 Adequate storage of water in underground + overhead domestic water tanks.
- 1.3 Levels of roads / pavements and other services in the area.
- 1.4 Landscape layout.

The execution of works and materials used shall be as per the latest relevant I.S. specifications.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities

2. CONCEPT OF THE SYSTEM

The following services are envisaged for the building:

- 2.1 Domestic water supply through gravity system.
- 2.2 Sewage and Sullage collection system based on IS: 1742 and applicable standards for domestic drainage and connected to outfall into master sewer system

- 2.3 Storm / Rainwater drainage system from various levels of the building and disposal to Rainwater harvesting and over flow to into master system.

3. WATER STORAGE & DISTRIBUTION SYSTEM

3.1 Water Requirement

The water requirement for this project is proposed to be as per the provisions in IS: 1172/NBC and prevalent practices.

3.2 Source of Water

It is expected that part of the daily domestic water requirement for the Complex shall be through master water supply.

4. SEWAGE, SULLAGE AND STORM WATER

The soil and waste shall be carried down through one pipe/ 2 pipe drainage system. Venting of system shall be carried out by using separate anti syphonage pipe.

5. WORKMANSHIP

The workmanship shall be best of its kind and shall confirm to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the Owner's Site Representative. All materials and/or Workmanship which in the opinion of the Owner's Site Representative / Architect / Consultant is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

6. MATERIALS

All materials shall be best of their kind and shall confirm to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the Owner's Site Representative / Architect / Consultants.

As and when required by the Owner's Site Representative / Consultant, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If after tests any materials, work or portions or work are found defective or unsound by the Owner's Site Representative / Consultant, the contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfaction of the Owner's Site Representative / Consultant. To prove that the materials used are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

*SECTION I: GENERAL INSTRUCTIONS***1.0 GENERAL REQUIREMENTS****1.1 Scope of Work**

1.1.1 The form of Contract shall be according to the “Conditions of Contract”. The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.1.2 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.

1.1.3 Without restricting to the generally of the foregoing, the sanitary installations shall include the following:-

A. Plumbing Works

- i) Sanitary Fixtures
- ii) Soil, Waste & Vent and Rainwater Pipes and fittings.
- iii) Water Supply System (Cold & Hot).
- iv) Sewerage & Storm water drainage system
- v) heat pump system

1.1.4 Services rendered under this section shall be done without any extra charge.

1.2 Specifications

1.2.1 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

1.2.2 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with up-to-date amendments as applicable in the contract and or as per the requirement of the client or its representative.

1.2.3 Works not covered above in para 1.2.1 and 1.2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British Standard Code of Practice.

1.3. Execution of Works

1.3.1 The Contractor should visit and examine the site of work and satisfy himself to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on grounds of insufficient description will be allowed.

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

1.3.3 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provisions for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

1.3.4 On award of the work, Contractor shall submit a schedule of construction in the form of a PERT Chart or BAR Chart for approval of the Project Manager/Architect/Consultant. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

1.4 **Drawings**

1.4.1 Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

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

1.4.3 Contractor shall verify all dimensions at site and bring to the notice of the Project Manager all discrepancies or deviations noticed. The decision of the Project Manager shall be final.

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

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

1.5 **Inspection and Testing of Materials**

1.5.1 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

1.5.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

- a) Theodolite, Steel tapes
- b) Dumpy level
- c) Weighing machine
- d) Plumb bobs, Spirit levels, Hammers
- e) Micrometers, Tachometers
- f) Thermometers, Stoves
- g) Hydraulic test machine
- h) Smoke test machine

1.5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.

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

- 1.5.5 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Architects or kept at site in a sample room as prepared by the owners. Any materials declared defective by Project Manager/Architect/Consultant shall be removed from the site within 48 hours.

1.6 **Metric Conversion**

- 1.6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.
- 1.6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

1.7 **Reference Points**

- 1.7.1 Contractor shall provide permanent Benchmarks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 1.7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

1.8 **Reference Drawings**

- 1.8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All-important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.
- 1.8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Project Manager or Architects.

1.9 **Shop Drawings**

- 1.9.1 The Contractor shall submit to the Project Manager three copies of the shop drawings.
- 1.9.2 Shop drawings shall be submitted under following conditions:-
- (a) Showing any changes in layout in the plumbing drawings.
 - (b) Equipment layout, piping and wiring diagram.
 - (c) Manufacturer's or Contractor's fabrication drawings for any materials or equipment supplied by him.
- 1.9.3 The Contractor shall submit two copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the Project Manager.

1.10 **Completion Drawings**

- 1.10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Project Manager. 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 upto 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.
- No completion certificate shall be issued unless the above drawings are submitted.
- 1.10.2 Contractor shall provide two sets of catalogues, service 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.
- 1.10.3 All "Warranty Cards" given by the manufacturers shall be handed over to the Project Manager.
- 1.11. **Contractors Rates**
- 1.11.1 Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.
- 1.11.2 Rates quoted are for all heights and depths and in all positions as may be required for this work.
- 1.11.3 All rates quoted must be for complete items inclusive of all such accessories, Fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.
- 1.11.4 All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by Project Manager. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.
- 1.11.5 The Contractor shall furnish the Architects with vouchers and test certificates, on request, to prove that the materials as specified and to indicate that the rates at which the materials are purchased in order to work out the rate analysis of non tendered items which he may be called upon to be carried out.
- 1.12. **Testing**
- 1.12.1 Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications.
- 1.12.2 Tests shall be performed in the presence of the Project Manager/ Consultant.
- 1.12.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.
- 1.12.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.
- 1.12.5 Contractor shall provide all labour, equipment and materials for the performance of the

tests.

1.13 Site Clearance and Cleanup

- 1.13.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.
- 1.13.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.
- 1.13.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

1.14 License Permits and Authorities

- 1.14.1 Contractor must keep constant liaison with the Municipal/statutory authority and obtain all approval of all drainage, water supply and other works carried out by him.
- 1.14.2 Contractor shall obtain, from the Municipal and other authority's necessary completion certificate(s) with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. Employer shall pay all fees/deposits as required to be paid to the authorities towards connection charges.

1.15 Recovery of Cost for Materials issued to Contractors Free of Cost

- 1.15.1 If any materials issued to the Contractor free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. plus 100%. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

1.16 Cutting of Water Proofing Membrane

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of Project Manager/Architects. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of water proofing approved by Architects.

1.17 Cutting of Structural Members

No structural member shall be chased or cut without the written permission of the Project Manager.

1.18. Materials Supplied by Owner

- 1.18.1 The Contractor shall verify that all materials supplied by the Employer confirm to the

specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Project Manager.

1.19 Materials

- 1.19.1 Unless otherwise specified and expressly approved in writing by the Project Manager, only materials of makes and specifications mentioned in the list of approved makes attached with the specifications shall be used.
- 1.19.2 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Project Manager and returned to the Contractor at the appropriate time.

SECTION II: SANITARY FIXTURES

2. SANITARY FIXTURES

2.1 Liquid Soap Container

- 2.1.1 Liquid Soap Container shall be of approved quality.

2.2 Towel Ring

- 2.2.1 CP Brass 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

2.3 Coat Hook

- 2.3.1 Coat hook shall be of brass material and chrome color double hook type of approved make & quality.

2.4 WC Pan Connector

- 2.4.1 straight / offset type flexible single body push fit type WC pan connector of with integral single mould sealing fins made of flexible EVA body to be fixed with manufacture supplied grease, including rubber bush / adaptor for use with uPVC pipe

2.5 Sink Mixer

- 2.5.1 CP Brass Single lever mixer for sink approved make & quality.

2.6 Water cooler

- 2.6.1 water cooler with Inbuilt Aquagaurd / Equivalent RO purification + UV(50LPH). Cooling capacity shall be 100 liter & 150 liter shall be storage capacity. Its should have 7 stages purification process, fully automatic, rectangular tank with Forced fin and tube condenser, Non-corrosive SS-304 outer body, Food-grade SS-304 stainless steel inner tank (18/8 or 18/10), PUF insulation, Reciprocating compressor with R22 Refrigerant. Water outlet temp is approx. 17 deg c, Operating power supply 230 + 10% V AC, 50 Hz, 1 PH

2.7 Two-way bib cock

- 2.7.1 C.P. brass Two-way bib cock of approved quality conforming to IS:8931 approved make & quality.

2.8 Health faucet

- 2.8.1 CP Health faucet to European type W.C. Of approved quality & make.

2.9 Towel rail

- 2.9.1 CP Brass towel rail complete with brackets with CP brass screws with concealed fittings arrangement of approved quality and colour.

2.10 Soap Dish Holder

- 2.10.1 CP Brass Soap Dish Holder complete with brackets with CP brass screws with concealed fittings arrangement of approved quality and colour.

2.11 Measurement

- 2.11.1 Sanitary fixtures and accessories shall be measured by numbers in the unit given in the Schedule of Quantities.
- 2.11.2 Rates for all items shall be inclusive of cutting holes and chases and making good the same, C.P brass screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.

SECTION III: WATER SUPPLY SYSTEM**3. WATER SUPPLY SYSTEM****3.1 Scope of Work**

- 3.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- 3.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-
- a) Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
 - b) Cold water supply lines from main line to overhead water tanks.
 - c) Excavation and refilling of pipes trenches.
 - d) Insulation to hot & cold water pipes.
 - e) All the concealed by should be insulated by rubber nitrile insulation and all the exposed to wall pipe in the terrace
 - f) Pipe protection and painting.
 - g) Control valves, masonry chambers and other appurtenances.
 - h) Connections to all plumbing fixtures, tanks, appliances and Municipal mains

3.2 **General Requirements**

- 3.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.
- 3.2.2 Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 3.2.3 Short or Long bends shall be used on all main pipelines as far as possible. Use of Elbows shall be restricted for short connections.
- 3.2.4 Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 3.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 3.2.6 Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.
- 3.2.7 All pipe clamps, supports, nuts, bolts, and washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.
- 3.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3.3 **Water Supply System**

- 3.3.1 Contractor should study the site plan and water supply system diagram for an overview of the system.
- 3.3.2 Source:
Water supply will be acquired from master line and collected in over head water storage tanks.

3.4.1 **Pipe Supports**

- 3.4.1.1 All pipes clamps, supports, hangers, rods, pipe supports, nuts and washers shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirements.
- 3.4.1.2 SS pipes in shafts and other locations shall be supported by galvanized M.S clamps of design approved by pipes in wall chases shall be anchored by G.I hooks, pipes at ceiling level shall be supported on structural clamps fabricated from M.S structural steel. Pipes in typical shafts shall be supported on Galvanised slotted angles/channels as specified elsewhere.

3.4.1.3 **Clamps**

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Project Manager. Pipes in wall chases shall be anchored by iron hooks, Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural steel as described above. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

3.5 **Anchor Fasteners**

- 3.5.1 All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by an approved type of power drill as recommended and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility, and the contractor shall redo or provide additional support at his own cost. He shall also compensate the owner for any damage that may be caused by such failures.

3.6 **Unions**

Contractor shall provide an adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Project Manager.

3.7 **Flanges**

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S.780. and C.I. butterfly valve to IS: 3095.

3.8 **Valves**

3.8.1 **Ball Valves**

Valves upto 50 mm dia. shall be screwed type Ball Valves with stainless steel balls spindle teflon seating and gland packing tested to a hydraulic pressure of 16 kg , sq.cm., and accompanying couplings and steel handles.(to BS 5351) protected with thermal insulation.

3.9 **Butterfly Valves – Slim Seal Type**

- 3.9.1 Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.
- 3.9.2 Butterfly valve shall be of the best quality conforming to IS: 13095.

3.10 **Non-Return Valve (Dual Slim Type)**

Where specified, non return valve shall be provided through which flow shall occur in one direction only.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair

of flanges screwed or welded to the main line and having the required number of nuts, bolts and washers of correct length.

SECTION IV

Soils, Waste, Vent Pipes & Fittings

4 Scope of work

Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings and as given in the Schedule of Quantities.

4.1 Without restricting to the generality of the foregoing, the work shall include the following:-

- a) Vertical and horizontal soil, waste, vent, and fittings, joints, clamps and connections to fixtures.
- b) Soil & waste pipes to external sewers line.
- c) Connection of all pipes to sewer lines as shown on the drawings at the ground floor.
- d) Floor and urinal traps, cleanout plugs, inlet fittings.
- e) Testing of all pipe lines.

4.2 General requirements

- 4.2.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Project Manager /Architect.
- 4.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 4.2.3 Pipes shall be fixed in a manner to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 4.2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps an interval specified.
- 4.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

4.3 Piping System

4.3.1 Soil, Waste & Vent Pipes

- a) The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in IS: 5329, having separate pipes for waste from kitchen sinks, bath tubs, showers, washbasins, AHU's condensate drains and floor drains and is approved by the local authority. Waste stacks have been provided with a "P" trap at basement ceiling.
- b) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement floor ceiling as shown on the drawings.
- c) All Floors of toilets, kitchens and other service areas located on structural slab are SUNK by 300 mm to accommodate all soil & waste pipes.

- d) All soil and waste from areas below general ground level will be collected in sumps and pumped into sewer lines.
- e) Anti-siphonage pipe (ASP) shall be provided for soil fittings on vertical stacks. It may also be provided for waste lines where shown on the drawings.

4.5 Fixing

- 4.5.1 All vertical pipes shall be fixed truly vertical to walls with approved type of GI clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-
- 4.5.2 Horizontal pipes running on the floor shall be covered with cement concrete grade M-10, 75mm thick in bed and 75mm thick all around soil and waste pipes under floor.
- 4.5.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Project Manager/Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces at no extra cost.

4.6 Clamps

- 4.6.1 Holder bat clamps shall be of standard design and fabricated from **galvanized MS standard flats** 40x3 mm thick and 12 mm dia MS rod and 6 mm nuts and bolts. Holder bat clamps shall be fixed in cement concrete 1: 2 : 4 mix blocks 10x10x10 cms deep.
- 4.6.2 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.
- 4.6.3 For SWR pipes conforming to IS: 13592 shall be clamped to wall with approved type of uPVC saddle clamp/U-clamp or as given in the Bill of quantities.
- 4.6.4 Structural clamps shall be fabricated by electro-welding from MS structural members e.g. rods, angles, channels flats as per detailed drawing. Contractor shall provide all nuts & bolts, welding material. All fabricated clamps, nuts, bolts and washers shall be not dipped galvanized.
- 4.6.5 Galvanized slotted angle/channel supports on walls shall be provided wherever shown on drawings. Angles/channels shall be of sizes shown on drawings or specified in schedule of quantities. Angles/channels shall be fixed to brick walls with bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. The spacing of support bolts horizontally shall not exceed 1 m.
- 4.6.6 Wherever MS 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 Project Manager.
- 4.6.7 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

MARKINGS:

All pipes shall carry the following markings: Time and date of manufacture; company name; dimension, application class, barcode and material details.

FITTINGS:

Single- Layered fitting in PP, a reinforced wall and factory fitted lip ring, hot water resistant upto 95 degree c in accordance to EN 1451-PART 1-6EN 12056 PART 1-5.

INSTALLATION: The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds (refer manufacturer's installation guide lines). The piping must not touch any wall, structure, paneling, false ceiling etc.

4.5 Traps**4.5.1 Floor traps**

Floor traps shall be siphon type full bore P or S type cast iron having a minimum 50 mm deep seal. The trap and waste pipes in sunken area (where required) shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30x30 cms of the required depth.

4.5.2 Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from uPVC pipe without, with one, two or three inlet sockets fixed on side to connect the waste pipe. Joint between waste and hopper inlet socket of the trap shall be joined with solvent cement recommended by the manufacturer. Inlet shall be connected to an uPVC. P or S trap. Floor trap inlet hoppers and the traps if set in cement concrete blocks as specified in para above without extra charge. UPVC multi-inlet trap can be used wherever possible to be decided by the project Engineer.

Trap & Seals

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

Appliance or ware	Material	Trap Type	Seal depth(mm)
Lavatory /wash basin	C.P. cast brass	32 mm dia Bottle	75 mm
Sink	C.P. cast brass	40 mm dia Bottle	75 mm
Kitchen floor drain of fabricated drain boxes	uPVC/C.I.	75/100 mm dia 'P' or 'S'	50 mm
Urinals	uPVC/C.I.	100 mm dia 'P' or 'S'	50 mm

4.5.3 Floor Gratings

Floor and urinal traps shall be provided with 100-150mm square or round CP/stainless steel grating, with rim of approved design and shape. Minimum thickness shall be 4 mm or as specified in the Schedule of Quantities.

4.5.4 Jointing

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

4.6 Cleanout Plugs

4.6.1 PP Clean out pipe for Soil, Waste pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout pipe shall terminate flush with the floor levels.

4.6.2 Cleanout on Drainage Pipes

- a) Cleanout pipe shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Project Manager. Cleanout pipe shall be of size matching the full bore of the pipe but not exceeding 160 mm OD.
- b) Cleanouts at ceiling level pipe shall be provided with a bend terminating at floor level above. The cap of the cleanout pipe shall have a cap flush with floor.

4.7 Waste pipe from appliances

4.7.1 General

- a) Waste pipe from appliances e.g. wash basins, sinks and urinals shall be of noise insulated Polypropylene piping system as per DIN EN 12056 and DIN1986-100 with 3 layer pipe made of External layer -PP, middle layer-Mineral reinforced PP, Internal layer-PP. push-fit type, food safe, having high impact and stiffness, offering sound levels of not more than 10 dBA as per DIN 4109 at a flow rate of 2 l/s and having pipe ring stiffness as per ISO/DIS 9969 and tightness as per EN 1277/B and C and DIN 19560, density of pipe = 1.9 g/cm³, elongation break 50% and tensile strength 20 N/mm², Coefficient of linear expansion 0.09 mm/mK PP pipe 40, 50 mm OD as given in the Schedule of Quantities.
- b) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per the pipe spacing chart given in section 1.

4.8 Encasing pipe in Cement Concrete

uPVC soil and waste pipes and drainage under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1 : 2 : 4 mix (1 cement : 2 coarse sand : 4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of one meter. Rate for concreted round pipes shall be inclusive of pillars, supports, shuttering and centering.

4.9 Cutting and making good

- 4.9.1 Contractor's rate shall include for providing all necessary holes, sleeves, cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1 : 2 : 4 (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nominal size) or cement mortar 1 : 2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

4.10 Testing

- 4.10.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.
- 4.10.2 Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing equipment/motors etc. shall be certified for its calibration by an approved laboratory.
- 4.10.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.
- 4.10.4 Testing soil, waste and rainwater pipes
- a) Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.
 - b) After installation all connections from fixtures, vertical stacks and horizontal drains including pipes along ceiling shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.
 - c) After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self draining, has no leakages, blockages etc. Rectify and replace where required.
- 4.10.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in the presence of Project Manager and signed by both.

4.11 Measurements**4.11.1 General**

- a) Rates for all items quoted shall be inclusive of all work and items given in the specifications and Schedule of Quantities.
- b) Rates are applicable for the work in basements, under floors, in shafts at ceiling level area for all heights and depths.
- c) Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.
- d) Rates are inclusive of pre-testing, on site testing, of the installations, materials and commissioning of the works.
- e) Pipes (unit of measurement. Linear meter to the nearest centimeter)

4.11.2 Pipes shall be measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, crosses, etc. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal outer diameter.

4.11.3 Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

4.11.4 Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

4.11.5 Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

4.11.6 Excavation for soil pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs or over basement rafts.

4.11.7 Project Manager's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

EXTERNAL SEWERAGE & STORM WATER WORK
SECTION V: SEWAGE & STORM WATER WORK

5. Sewer work & Storm water Work

5.1 Scope of work

5.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

5.1.2 Without restricting to the generality of the foregoing, the drainage system shall include:-

- a) Sewer lines including excavations, pipelines, manholes, drop connections and connections to the existing sewer.
- b) Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels and connections to the existing storm water drain.

5.2 General requirements

5.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Project Manager.

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

5.2.3 All drainage work shall be done in accordance with the local municipal bye-laws.

5.2.4 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

5.2.5 Location of all manholes, etc. shall be got confirmed by the Contractor from the Architect / Landscape Architect. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Project Manager.

5.2.6 In sewer line pipe DWC HDPE SN8 conforming to 16098 Part II pipe will be used.

5.3 DWC HDPE Pipes (SN 8): IS 16098 Part II

5.3.1 DWC pipes shall be of first class quality and free from rough texture inside or outside and straight. All pipes shall have the manufacturers name marked on it and shall comply with IS-16098 Part II and shall be of approved makes.

5.3.2 Laying and Jointing of DWC HDPE Pipes

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

- b) The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.
- c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete 1:5:10 mix at the Contractor's cost and charges.
- d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed of 1:5:10 mix to ensure even bearing.

5.3.5 **Jointing of Pipes**

- a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.
- b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement: 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 degrees with the barrel of the pipe. The mortar shall be beaten up and used after it has begun to set.
- c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper or "Badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials, which can be kept damp, shall be used. The joints shall be exposed and space left all rounds the pipes for inspection by the Project Manager. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length and shall efficiently drain and discharge.

5.4 **Testing**

- All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

- Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end. (ii) means of a mirror at one and a lamp at the other end. If the pipeline is straight the full circle of light will be seen otherwise obstruction or deviation will be apparent.
- The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Project Manager.

A test register shall be maintained which shall be signed and dated by Contractor.

SECTION VI: HEAT PUMP SYSTEM

Heat pumps shall be of 5000 Ltr capacity with minimum COP of 3.5. Refrigerant used should be environment friendly R-410a. Heat pump will heat water upto 55°C on heat pump mode. It will have silent operation, and the sound level should not exceed 65 dB. Heat pump will have LCD display control panel with built in diagnostic and troubleshooting information. Heat pump will have an inbuilt cycle for defrosting in case icing occurs on evaporator. Heat Pump will have Temperature sensor, air relief valve and all accessories to run the heat pump on auto mode. The input & output power can vary as per manufacturer specification.

Heating Capacity: 35 Kw (Thermal Output)

Power consumption: 8.2 KW (Electrical Input)

Rated hot water Output: 752L/hr

Refrigerant: R-410a

Compressor: Scroll

Hot Water Outlet Temperature: 55 °C -60°C

Hot Water Supply & Return Pump

Pumps suitable for 415 volts connected with T.E.F.C. induction motor, M.S. Channel, base plate complete with vibration isolator, isolating valves on suction and discharge, pressure gauge with stop cock and dial type thermometer on suction & discharge. The pump shall be mechanical seal. The pump shall be SS casing, impeller, shaft and CI (Epoxy coated) base & EPDM Mechanical seal as required pump for circulation of water to heat pump. Including panel, cable, foundation, piping valves etc.

SECTION VII: WATER COOLER

Water cooler with Inbuilt RO purification + UV(50LPH). Cooling capacity shall be 60 liter & 80 liter shall be storage capacity. It should have 7 stages purification process, fully automatic, rectangular tank with Forced fin and tube condenser, on-corrosive SS-304 outer body, Food-

grade SS-304 stainless steel inner tank (18/8 or 18/10), PUF insulation, Reciprocating compressor with R22 Refrigerant. Water outlet temp is approx. 17 deg c, Operating power supply 230 + 10% V AC, 50 Hz, 1 PH, No of Cold Water Faucet-2.

SECTION VIII PUMPS & EQUIPMENTS.

8.0 Pumps & Equipment

8.1 Work under this sub-head consists of furnishing all labour, materials, equipment and accessories necessary and required to completely install pumping system for various water supply services and water treatment as per drawings, specified hereinafter and given in the Bill of Quantities.

8.2 Without restricting to the generality of the foregoing, the work of pumps and water treatment equipment shall include the followings:

- a) Hydropneumatic pump for domestic water supply for upper 2 floors
- b) Motor control panels, power and control cabling and allied electrical works.
- c) Pipes, valves, accessories, hangers, supports, delivery and suction feeders and connection to proposed pipe work.

8.3 PUMP SET

8.3.1 Water Supply Pumps

(These specifications are applicable for all clear water pumps and as specified in Bill of Quantities)

8.3.2 Water supply pumps shall be suitable for clean water. Pumps shall be single or multistage, monoblock horizontal, vertical, centrifugal pumps with cast iron/stainless steel body and stainless steel/bronze impeller, stainless steel shaft and coupled to a TEFC electric motor by means of a flexible coupling or as specified in bill of quantities. Each pump should operate a curve 10m below specified head.

8.3.3 Pump and motor shall be mounted on a common M.S. structural or C.I. base plate or as required as per site conditions.

8.3.4 Each pump shall be provided with a totally enclosed fan cooled induction motor of required H.P. and RPM specified in the bill of quantities and as per requirement.

8.3.5 Each pumping set shall be provided with a 150mm dia or of suitable size gunmetal "Bourden" type pressure gauge with gunmetal isolation cock and connecting piping.

8.3.6 Provide vibration-eliminating pads appropriate for each pump.

8.3.7 Provide rate of flow measuring meter with bypass arrangement with every set of pumps as shown on the drawings and given in the bill of quantities (to be paid separately).

8.3.8 All water supply pumps shall be provided with mechanical seals, of required specifications.

8.4 Hydro pneumatic Pumping System with Variable Frequency Drive

- i. In- line vertical Single / Multistage centrifugal clear water pump set with SS-304 casing, SS-304 impeller with SS-316 shaft, CI base with CED coating complete directly

coupled with TEFC induction motor of class "F" insulation & efficiency class IE-3, 2900rpm, suitable for operation on 415 Volts $\pm 10\%$, 3 phase, 50 Hz A.C. supply complete.

- ii. The entire system shall be mounted on a common base frame i/c common suction and common delivery of G.I heavy class pipe headers with flanges, interconnecting piping with all required Control Valves, Non-return valves, pressure guage with isolation cock etc. and all required accessories.
- iii. Pressure vessel capacity 100 & qty 1 of non-corrosive FRP composite construction lined with NSF/ FDA listed material, like high density polyethylene with fully replaceable polyurethane. Air cell burst pressure of minimum of (3 / 5) times the vessel operating pressure and prototype cycle tested for (80,000 / 2,50,000) cycles with charging connections to discharge pipeline with necessary flanges, gaskets, isolating valve, nuts / bolts etc. with suitable foundation bolts & other accessories, complete as required.
- iv. Panel mounted microprocessor multi pump controller with large graphical display and variable frequency drive (VFD) mounted inside a panel complete with pressure sensor transmitter. The graphical display capable to show number of pumps running & also communicate with other controllers following with open protocol through RS485 port. System should be capable to compensate for frictional losses at lower flows. All alarms should be displayed in the controller. The panel should also have provision for manual / automatic alternate (cyclic) operation of pumps, ON / OFF switch
- v. Necessary foundation bolts, vibration elimination pads and other accessories complete as required.
- vi. The entire system along with pumps & control panel must be sourced from single manufacturer only for unit responsibility.

LIST OF APPROVED MAKES

1. All materials and equipment used in execution of work shall be of approved makes listed below. Any make offered by Tendered other than the approved makes will be subject to the approval of Owner/ Architect/ Consultant/ Interior Designer. If other makes are offered, the same shall be clearly indicated in tender.
2. Contractor shall list out the makes of equipment and materials offered during tender stage itself. Decision about the final selection of the make from the makes included in Agreement shall rest with the Owner/ Architect/ Consultant as applicable.

S No	Item / Material	Make
1	Sanitary ware & CP Fittings	Hindware / Jaquar/ Parryware/ Bathsense
2	CP Fittings	Hindware / Jaquar/ Parryware/ Bathsense
3	SS Sink	Jayna / Nirala/ Hindware/ Nilkanth
4	Geyser	AO Smith/ Jaquar/ Venus
5	Drinking Water cooler	Bluestar/ Usha/ Voltas
6	WC Pan Connector	Mcalpine/ Supreme/ Astral/ Finolex
7	Butterfly Valve	Zoloto/ Sant/ Lehry
8	Check Valve	Zoloto/ Sant/ Lehry
9	Ball Valves	Zoloto/ Sant/ Lehry
10	Pressure Reducing Valves	Zoloto/ Sant/ Lehry
11	Water Meter	Kranti / Kent/ Lehry
12	uPVC Pipes & Fittings	Birla Aercon/ Ashirwad/ Astral
13	CPVC Pipes & Fittings	Birla Aercon / Ashirwad/ Astral
14	Stainless Steel Grating	Jayna/ Neer / Chilly
15	PP Pipes	Astral / HT Safe/ Walsir
16	CI Pipes	Neco/ Hepco/ SKF
17	Channel Grating	Jayna/ Neer / Chilly
18	PP Floor Trap	Astral / HT Safe/ Walsir
19	PP Floor Drain	Astral / HT Safe/ Walsir
20	PP Multi Trap	Astral / HT Safe/ Walsir
21	Air Release Valve	Sant / Zoloto/ Lehry
22	SW Gully Trap	Anand
23	SS Pipe	Jindal/ VSH/ Tata
24	GI Pipes as per IS:1239	Surya Prakash/ Jindal hissar/ Tata/ APL Apollo
25	GI Fittings (Malleable Cast Iron) as per IS:1879	Zoloto / Sant/ Surya Prakash
26	Cables	Polycab/ Sky tone / Finolex

S No	Item / Material	Make
27	RCC Pipes	Om spun Pipes/ Indian Hume Pipe/ Jain Spun pipes/ Shri Balaji Spun Pipe
28	HDPE DWC Pipe	Astral/ Prince/ Supreme
29	S.F.R.C. Manhole covers	Om Spun pipe/ KK Manhole / BRHC
30	CI Manhole covers	NECO / KK / Bengal Iron Corporation
31	Ductile Iron pipe	Jai Balaji/ Jindal Saw Ltd/ Electro steel/ Tata
32	DI Fittings	Electro steel/ Kejriwal/ Jai Balaji (Supra)
33	PVC encapsulated Foot rest	KK Manhole / KGM / Bentex
34	Pumps	Xylem / Lubi / Ground foss
35	Heat Pump	AO Smith/ benchmark/ Suntec
36	Solar Panel	Bipsun/ Green tek/ Inter solar
37	Filter & Softener	MSEP
38	Chemical Dosing Pumps/Tanks	Toshcon/ ASIA LMI/Edose
39	Level Controller / Lvel Sensor	AIP /Danfoss / Flow line
40	Pressure Gauge	H Guru/ Fiebig/ Emerald
41	Strainer	Sant / Zoloto/ Lehry
42	Pressure Switch	L&T/ Johnson/ Honeywell
43	Fire Sealant/ Fire Reterdant paint	3M/ Hilti/ Powers
44	Pipe Support & Clamps	Chilly/ Euroclamp/ Easyflex
45	Pipe Hangers	Gripple/ Hitech/ Om Fasteners
46	Paints	Asian paints/ Berger / Shalimar Paints
47	Welding rods & Electrodes	Ador/ Cosmos/ Prima (S)
48	Fastener	Fisher/ Hilti/ Mungo
49	Vibration Eliminator	Resistoflox, Noida/ Dwren - Calcutta
50	a) Starter	L & T/ Siemens
	b) SFUs	L & T/ Siemens
	c) Cables	Finolex/ Bonton
	d) Liquid Level Controller	Femack/ Minitec
	e) MCCB	ABB (Imported)/ Merlin Gerin (French Series)/Mitsubishi
	f) MCB	Legrand (Imported)/ Merlin Gerin (France)/ Hager (Imported)
	g) Panel	Tricolite Industries/ Installation control panel /risha Control

..... END OF PLUMBING TECHNICAL SPECIFICATION.....

TECHNICAL SPECIFICATION OF FIRE FIGHTING WORKS:

1. **Technical Specification of DSR items of Fire Fighting works (Based on DSR E&M 2022) mentioned in SOQ shall be as per CPWD General Specification for electrical works Part V (WET RISER AND SPRINKLER SYSTEM) 2020.** (Corrected up to the last date of submission/uploading of bid).
2. Specification/brands names of fixtures to be used as per the scope of work are listed in the bid documents. The efforts should be made by the Contractor to use indigenous products. The Contractor should also consider the availability of spares parts/ components for maintenance purposes while proposing any brand/ manufacturer. The materials of any other brand/manufacturer may be proposed for use by the Contractor in case the brands specified below are not available in the market and/or Contractor intends to use some other brand better than the brands mentioned in this list. The alternate brand can be used only after the approval of Engineer-in-Charge-in-Charge. The list of approved makes is appended to this document.

3.1 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 Fire Fighting System as described herein after and shown on the drawings. The scope of work in general shall include the following:

- i) Fire Fighting Pumps & Accessories and related electrical works.
- ii) Fire Hose Cabinet System.
- iii) Hand Appliances.
- iv) Connection from External campus fire fighting system

Without restricting to the generality of the foregoing, the work shall include the following:

A Down comer System covering the entire complex and consisting of the following:

- v) Two numbers of Pumps – Horizontal type, multistage, centrifugal, split casing Terrace pump of 450 LPM 35 M Head. (1 Working + 1 stand by)
- vi) Other piping system ancillaries such as Suction and Delivery Headers, Air Vessel, Pressure Gauges, Pressure Switches, Pump Panel etc. as required.
- vii) Internal Hydrant system where required with single headed landing valves on each floor accompanied by 1 number swinging type Hose Reel, 2 numbers RRL Hoses, 1 number of Branch Pipe etc. all housed in the niche. Bidder shall provide front frame with shutter for niche.
- viii) Hand appliance such as Fire Extinguisher.
- ix) To obtain the approval of the relevant drawings before actual installation at site and to get the complete installation inspected and passed by the concerned authorities, as may be necessary as per local bye-laws. (any fee payable to the local bodies.

3.2 Contractor's Experience.

- 3.2.1 Contractors shall engaged specialist agency only for this work of Fire Fighting systems.
- 3.2.2 The selected specialist agency must have sufficient experience in the execution of turnkey projects as specified.
- 3.2.3 Contractor must submit with the tender a list of similar jobs carried out by him as required along with the name of works, name and address of clients, year of execution, capacity of plant and value of work.

3.3 Technical Information.

- 3.3.1 Contractor shall submit along with the tender copies of detailed specifications, cuts, leaflets and other technical literature of equipment and accessories offered by him.
- 3.3.2 Contractor's attention is specially invited to the special conditions and other clauses in the agreement which required the contractor to: -
 - a. Submit detailed shop drawings.
 - b. Use material of specific makes and brands
 - c. Obtain all approvals from Fire Fighting authorities.
 - d. Execute the entire work on a turn-key basis so as to provide a totally operating plant.

3.4 Exclusions.

- 3.4.1. Work under the contract does not include the following work.
- 3.4.2 Electrical cable up to incoming motor control centre.

3.5. Site Accessibility.

- 3.5.1 The equipments are to be located in pump house located within the Service block.
- 3.5.2 The equipment must be carried from the goods receiving station to the site in an extremely careful manner to prevent damage to the equipment building or existing services.
- 3.5.3 The contractor must visit the site and familiarize himself with the above problems to ensure that the equipment offered by him are of dimensions that they can be carried and planed in position without any difficulty.

3.6 Approvals.

The contractor shall prepare all submission drawings and obtain all approvals of firefighting works from firefighting authorities.

3.7 System Description.

- 3.7.2 The Fire Hose Cabinet System shall be semi-automatic in action and shall be covering all the floors internally.
- 3.7.3 The Fire Hose Cabinet System shall be kept pressurized at all times.
- 3.7.4 The pressure in the hosereel pipe work shall be minimum at 3.5 Kg/cm². In the event of

fire when any of the hydrant valve in the network is opened, the resultant fall in header pressure shall start the AC motor driven fire pump through pressure switches automatically.

- 3.7.5 The Internal Fire Hose Cabinet System shall be provided at points as indicated on the drawing on each floor.
- 3.7.6 The Fire Hose Cabinet point shall be directly tapped from the Riser pipes, and shall be furnished with required accessories such as –
One no. first aid hose reel 20mm dia x 30m long.
The Fire risers shall be terminated with air cushion tank at the highest points to release the trapped air in the pipe work.
An overhead tank 5000 liters capacity will be connected to the fire hydrant system.
- 3.7.7 To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges/water hammer in the underground pipe work Air Vessels shall be furnished in the pump room ear fire pumps. The air vessel shall be normally partly full of water and the remaining being filled with air which shall be under compression when the system is in normal operation.

3.8 MAIN ELECTRIC FIRE PUMP.

3.8.1 Scope

This section covers the details of requirements of the motor, starter and pump for the electrically operated fire pump.

3.8.2 General.

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts, 3 phase, 50 Hz A/C system. Both the motor and the pump shall be assembled on a common base plate of fabricated MS channel type or cast iron type.

3.8.3 Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided.

3.8.4 Fire Pump (Electrical)

The fire pump shall be horizontal end suction centrifugal type. It shall have a capacity to deliver 450 LPM as specified, developing adequate head so as to ensure a minimum pressure of 3.5 kg. per sq.cm at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 percent of the rated discharge, at a head of not less than 65 percent of the rated head. The shut off head shall be within 120 percent of rated head.

The pump casing shall be of cast iron to grade FG 200 to IS:210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze / brass / gunmetal. This shaft shall be of stainless steel.

Bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

The pump shall be provided with a plate indicating the suction lift delivery head,

discharge speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

3.8.5 Motor

The motor shall be squirrel cage A/C induction type suitable for operation on 415 volts 3 phase 50 Hz system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 21 vide IS-4691. The class of insulation shall be B. The motor shall be rated to continuous duty as per relevant IS and shall have a horsepower rating necessary to drive the pump at 150 percent of its rated discharge.

3.8.6 Motor Starter.

The motor starter shall be automatic star Delta type conforming to IS:1822-1967. The starter shall not incorporate under voltage or overload trip or single-phase preventor. The starter assembly shall be suitably integrated in the power control panel for the wet riser system.

Each pump shall be provided with vibration isolating pads of appropriate size.

3.8.7 Pipe Work:

The piping for exhaust outlet as well as fuel piping between fuel tank and the engine shall be with Medium class M.S.

3.8.8 Anti-Vibration Mounting.

Suitable vibration mounting duly approved by Engineer-in-Charge-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated in the report, which will be submitted to Engineer-in-Charge-in-charge before installation.

3.8.9 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 trickle condition. Ammeter to indicate the state of charge of the batteries shall be provided.

3.9 Other Control Components

Pressure Switches.

Pressure switches shall be provided for switching on and off the pressurization pump at present pressures and also for switching off the fire pump at present pressure. Being the main component for initiating the signal for the operation of the pumps, the pressure settings shall be totally reliable, sturdy in construction and of long life. The pressure settings shall be adjustable.

Power Supply for Controls.

In order to ensure that the control systems remain co-operational at all times the control system shall be designed for 24 VDC operation fed from the battery. This shall

be independent of the starting battery for the engine i.e. battery shall remain trickle charged at all times from the separate battery charger at the control system.

3.10 Electrical Work and Earthing.

This section covers the detailed requirements of electrical works including earthing, for the materials installation.

Electric power supply shall be terminated in the incoming switch gear of the power and control panel by the Department. All further connections to the various components of the system shall be the responsibility of the contractor, for a complete and working system, satisfying all the functional requirements.

The scope shall particularly include the following:

Power and Control Panel(s) as given in relevant section.

All inter-connections with multi-core armored copper cables of size suitable between various control units and control panel(s)

All power cable connections with multi-core armored aluminum cables of size as specified in BOQ, between panels, motors etc.

3.11 Fire Extinguisher

i) ISI marked (IS:15683) Fire Extinguisher, Carbon-di-oxide type capacity 4.5 Kg. Flat base including valve, discharge hose of not less than 10 mm dia, 1M long and complete in all respects including initial fill with CO₂ gas conforming to IS:307-1966 and wall suspension bracket.

ii) 6kg ABC (Powder Type) Fire Extinguisher. Mild Steel Cylinders ISI marked fitted with pressure indicating gauge, internal tube, squeeze lever type valve fully charged with ABC 90 powder (Mono Ammonium Phosphate) pressured by Nitrogen complete in all respects including wall suspension bracket and conforming to IS:15683.

Standard and Codes.

1.	IS-1648-1961	Code of Practice for fire safety of building (general) Firefighting equipment and maintenance
2.	IS-3844-1966	Code of practice for installation of internal fire hydrant in a multi-storied building.
3.	IS-2217-1963	Recommendation for providing first aid and firefighting arrangements in public buildings.
4.	IS-2190-971	Code of practice for selection, Installation and maintenance of portable first fire appliance.
5	IS-3589	Electrically Welded Steel pipes (Medium class)
6.	IS-1239	Mild steel tubes, Tubular and other wrought steel fittings (Medium class)
7.	IS-780	C.I. Double flanges sluice valve.
8.	IS-778	Gun Metal Valve.
9.	IS-5290-1969	Internal Landing Valve.
10.	IS-884-1969	First and hose reel.
11.	IS-934-1976	Specification for portable chemical fire Extinguisher soda acid type.
12.	IS-2873-1969	Specification for fire extinguisher for carbon dioxide.

..... **END OF FIRE FIGHTING TECHNICAL SPECIFICATION**.....

TECHNICAL SPECIFICATIONS ELECTRICAL SYSTEMS

A. **SCOPE OF WORK:**

1. This specification covers general principles to be followed for the selection of electrical equipment and their installation, testing & commissioning. The electrical system consists of the following sub-systems,
 - LV Switchgears
 - Lighting system
 - Earthing system
 - Lightning protection system
 - Cabling system
 - Low voltage systems like DATA, Voice, TV and CCTV
2. The supply, erection, testing and commissioning of the entire electrical works shall be in line with local electrical norms, Indian standards and also basic concepts developed and laid down in this Technical specification.

B. **STANDARDS AND CODES:**

1. All electrical equipment and installations shall confirm to the NBC 2016, latest publication of Bureau of Indian Standards and codes of practice for installation and maintenance.
2. In case where Indian Standards are not available, the equipment and accessories shall confirm to the latest publications of International Electro technical Commission (IEC) or latest standards and codes of practice published by any other recognized National Standards Institutions.
3. All electrical equipment and installations shall also conform to the latest Indian Electricity Rules as regards safety, earthing and other essential provisions specified therein for installation and operation.
4. All installations shall comply with the statutory requirements of Government of India and CEIG.

C. **EXECUTION:**

1. The electrical installation shall be complete in all respects, in line with the specifications/drawings.
2. The contractor to appoint minimum three site engineers,
 - Site engineer-in-charge shall have minimum 15 years' experience with Under graduation in Electrical and Electronics engineering.
 - Site supervisors shall have minimum 5 years' experience with Diploma in Electrical and Electronics engineering
 - Before appointing the engineers, the CV shall be submitted for Clients approval.
3. The contractor to obtain all required permits/ licenses required for satisfactory execution and operation of the installation.
4. All receipted amounts shall be reimbursed by Client on production of proof of payment by the contractor.

5. The executed work shall strictly confirm to applicable laws, regulations and Indian Standards which become applicable.
6. Any conflict between DBR, drawings and specifications shall be brought to the notice of Client. The final decision will be taken by Client and contractor to follow Clients instructions.
7. The contractor shall co-ordinate with all other services like Civil, Structural, Plumbing and other agencies at site.
8. All required openings on wall/floor/ceiling shall be properly planned, the cut-out openings shall be made, properly finished and related all debris shall be removed by the contractor.
9. If any discrepancy on dimensions against drawings shall be brought to the notice of the engineer in charge.
10. All required shop floor drawings shall be prepared by the contractor and the same shall be submitted for approval of Client/Consultant.
11. On approval of shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement. This statement must be submitted prior to completing ordering of equipment and should identify imported/local materials in this contract as well as proposed spares/tools. The Consultant shall provide recommendation to Client representative for acceptance of anticipated variation in contract amounts and also advise Client to initiate action for procurement of spare parts and tools at the completion of project.
12. Contractor shall produce all equipment / system vendor drawings in three sets for Client/Consultants approval.
13. The manufacturing clearance shall be issued to the contractor by Client / Consultant for all the system/Equipments.
14. The contractor is responsible to update time to time changes in the hard copy of all the drawings for preparation of As-built documentation and it shall be approved by the Engineer in charge.
15. Obtain approval from Local Authorities prior & post installation for operation of system.
16. Handing over document comprising of list of recommended spares, catalogues and service schedule for each equipment/material, test reports of equipment's, testing & commissioning reports of systems.
17. Contractor to train the Client's staff.
18. DEFECTS LIABILITY PERIOD:
 - The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.
 - All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defect's liability period, all replacement parts and labor shall be supplied promptly free-of-charge to the Client.

D. LV SWITCHGEAR**Equipment specification:**

1. All the 415V AC, devices/equipment like bus support insulators, circuit breakers, VTs, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions:
 - Variation in supply voltage : $\pm 10\%$
 - Variation in supply frequency : $\pm 5\%$
 - Combined voltage and frequency variation : 10%

Construction:

2. The switchgear panel shall be designed, manufactured and tested in accordance with relevant Indian Standards. The panels shall be indoor, metal enclosed, single front, free standing type.
3. The insulators shall be made of high epoxy resin moulding.
4. The busbars and cable chambers shall be housed in separate chambers. The busbar and cable chambers should be fitted with bolted covers with gaskets and should be shrouded to avoid direct access to live parts immediately after opening respective covers. The busbars and jumper connections shall be insulated to full maximum operating voltage. The cubicle shall be designed for IP42 protection. The vermine proofing shall be such that the vermine cannot enter from one compartment to another/busbar chambers. Neoprene gaskets shall be used for all doors, covers and openings.
5. The busbars and connectors shall be made of high conductivity Aluminium. The busbars shall be amply sized to carry the rated continuous current under the specified ambient temperature without exceeding the total temperature of 85°C. Unless otherwise stated, the entire busbar shall be rated for the continuous rated current of the incomer. When sectionalised with a bus coupler, both the busbars shall be of the same rating. The entire switchboard along with all components shall be designed for the ambient site condition. The minimum area of cross section of the neutral shall be half that of the phase busbar, unless other wise specified.
6. The busbars and their connections shall be capable of withstanding, without damage, the thermal and mechanical effects of through fault currents equivalent to the short time rating of the switchgear. It shall be possible to extend the switchboard on both sides. The busbars shall be sleeved and with respected phase colour. The sleeves shall be rated for an insulation level of 660V. Each compartment shall have hinged doors with gaskets
7. Suitable lifting hooks shall be provided. These hooks when removed shall not leave any opening on the enclosure. Switchgear shall be designed for a bottom / top cable entry. The same shall be decided to suit site condition during detail engineering.

Insulators:

8. Insulators of moulded or resin bonded material shall have a durable, non-hygroscopic surface finish having a high anti-tracking index. Insulators, barriers made out of hylam, synthetic resin bonded paper, treated wood will not to be accepted.

9. Insulators shall be mounted on the switchgear structure such that there is no likelihood of their being mechanically over-stressed, during normal tightening of the mounting and busbars, connections etc.

MCCBs / SFUs

10. The MCCBs shall conform to the latest applicable standards. MCCBs shall be of three / four pole construction arranged for simultaneous four pole manual closing and opening.
11. 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.
12. Operating handle for operating MCCBs from door of board shall be provided.
13. MCCB / Switch fuse unit's terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
14. The switches shall be with silver plated contacts and capable of breaking safely full load current of associated equipment. Switches shall be quick make and break type and capable of breaking the circuit even if the mechanism spring fails. Barriers shall be provided to prevent inter phase arcing.
15. MCCB's up to 250A thermal magnetic type and 250A above microprocessor based and it shall have E/F & O/C release.

Current Transformers

16. The instrument transformers shall have synthetic cast resin insulation and be of the single-phase type.
17. The primary & secondary connections shall be clearly labelled.
18. All current transformers shall have insulation level and short time rating as per main switchgear. All current transformers shall be dimensioned to carry continuously a current of 120% of the rated current. The ratios shall be furnished in your drawings for our approval.

Meters, Relays and Other Accessories:

19. All relays shall be of switchboard pattern type suitable for flush mounting and fitted with dust tight cases and provided with reset devices. The relays shall conform to IS 3231 or BS 3950 and BS 142. Wherever called for, APFC relays of adequate steps shall be provided in the MCC panels.
20. Required CTs shall be provided in the incomer of the panels for feeding the APFC relay. The APFC relay shall be intelligent microprocessor-based type.
21. The capacitor panel shall be a separate panel. The capacitor panel shall consist of required no. of fuse switch, contactors, Aux. Contactors, timers and capacitors of specified rating. The scheme for capacitor feeders shall be suitable for Auto/ manual operation. In the auto mode, the capacitor feeders shall be controlled by APFC relay. In the manual mode the same shall be controlled by ON/OFF pushbuttons mounted on the front of respective feeders.
22. Suitable timers shall be provided in the manual mode of operation to ensure that a capacitor is not switched ON immediately after switching OFF.

Ammeters, Voltmeters, Kwh Meters:

23. All the meters shall be of Digital type, it shall be suitable for measuring unbalanced loads on a 3 - phase, 4 wire systems and shall operate on 415V 3 ϕ , 4 wires supply.

Indicating Lamps / Push Buttons:

24. These shall be switchboard type, low power consumption, LED type lamps complete with necessary accessories. Lamps shall be provided with screwed translucent covers to diffuse light. The lamp covers shall preferably be unbreakable, moulded, heat-resistant material and shall be provided with chromium plated bezels.
25. Push Buttons shall be heavy duty, push to actuate type with coloured button and inscription marked with its function. Each push button shall have minimum 2 NO + 2 NC contacts or as required, rated 10 A at operating voltage.
26. Push button shall be shrouded type except for emergency trip button (if provided) which shall be mushroom type for easy identification. Push button colour shall be as follows
- Stop/off - Red
 - Start/ON - Green
 - Reset - Yellow
 - Test - Black

Name Plate:

27. Suitable anodised aluminium name plate of 1.2 mm thick shall be provided on all the switchboards and individual compartments.

Earthing:

28. An earth bus of requisite section shall be provided. It shall extend throughout and solidly connect all panels in a line with proper terminals, at the end to connect to the station earthing system. The terminal arrangement at the ends shall be suitable for connection by 50x6 mm GI flat and shall be complete in the bimetallic washers etc.

Painting

29. The seven-tank process powder coating shall be carried out for all the LT panels and the colour shade shall be RAL 7032 (epoxy based). The vendor shall furnish painting procedure details along with the drawing submission.
30. All unpainted steel parts shall be cadmium plated or if these parts are on moving element, then these shall be greased.

General:

31. Deviations from our specification (if any) shall be brought out separately clause wise and explicitly. Deviations indicated in the guaranteed technical particulars (or) elsewhere shall not be considered / accepted.
32. The complete board shall be manufactured as per the standard practices and shall meet the requirements of CEIG and other relevant authorities.
33. CPRI approved panel fabricator to be engaged.

List of Drawings

34. Before taking up the fabrication; the panel fabricator shall submit the shop floor drawings for approval and one number sample panel board for Client & Consultant's approval.

35. Overall outline dimensions and general arrangement including plan, front elevation, rear & side elevations, clearances recommended in front and back.
36. Switchgear layout plan including floor openings, fixing arrangements and loading details
37. Schematic control diagrams to cover controls, protection, interlocks, instruments, etc.
38. Inter panel interconnection wiring diagram including terminal numbers and ferrule numbers.
39. The supplier shall be entirely responsible for the correctness of the internal wiring diagrams.
40. The supplier shall ensure that the characteristics of the CT's, fuses, protection relays, VT's and all other devices offered by him are such as to be suitable for the purpose.

Test Certificates

41. Type test certificates of all standard component parts, e.g. contactors, breakers, switches, fuses, relays, CT's, VT's, and for the standard factory-built assembly shall be submitted by the supplier.

INSTRUCTION MANUALS

42. The supplier shall furnish specified number of copies of the instruction manual which would contain detailed instructions for all operational & maintenance requirement. The manual shall be furnished at the time of dispatch of the equipment.

43. **Specific Requirement:**

1	System voltage	:	415V
2	No. of phase	:	Three
3	System frequency	:	50Hz
4	Voltage variation	:	<u>10%</u>
5	Frequency variation	:	<u>5%</u>
6	System Neutral Earthing	:	Effective earthed
7	Design ambient	:	50°C
8	Service	:	Indoor
9	Type	:	Metal enclosed, Compartmentalized
10	Degree of protection	:	IP42
11	Thickness of sheet steel		
a	Load bearing	:	2mm thick MS-CRCA
b	Non-load bearing	:	1.6mm thick MS-CRCA
c	MCB DB's	:	0.9 to 1.2mm thick
12	Paint	:	Pebble Grey shade (RAL 7032) powder coated
13	Support insulators	:	Epoxy
14	Protection	:	Refer respective SLD
15	Metering	:	Refer respective SLD
16	Indication		Refer respective SLD
17	CT & Protections	:	As per SLD.

Switch Gear Erection:

44. This shall be applicable to LT switchgear panels and other power and lighting distribution boards etc. Manufacturer's instructions, drawings, and instructions of the Engineer-in-charge should be studied and strictly followed during handling, erection, testing and commissioning of the switchgear.
45. The switchgear shall be handled with care, avoiding impact to the equipment by the experienced riggers under the guidance of the competent supervisor.
46. Dragging of the panels shall be avoided and use of a crane & trailer shall be made for the handling purposes while transporting to various sites.
47. The switchboards shall be properly supported on the truck / trailer by means of ropes to avoid any chances of damage or tilting due to heavy vibrations.
48. The switchboards shall be lifted by making use of lifting eye bolts only, fully tightened after ensuring that panel supports, nuts and bolts are all intact and tightened.
49. When lifting panels in packed conditions, utmost care shall be taken to avoid any damage to insulators, bushings, metering & protective equipment.
50. The panels shall be preferably kept inside the packing cases till foundations are ready.
51. Base channels shall be grouted, leveled in cement concrete pad for 415V switchgear panels and other cubicle panels. A level benchmark in each electrical room shall be given by purchaser as reference level and further all levels shall be checked and kept with the theodolite by the contractor. Pedestal type panels and MCCs shall be erected by grouting base channels by bolts. A proper bonding surface shall be made by chipping the floor while making cement concreting. All foundations, grouted bolts shall be cured for a minimum period of 48 hours.
52. The switchboard panels shall be taken out from the packed cases and moved one by one to the proper place. All the panels shall be assembled, aligned and leveled and it shall be ensured that panel to panel coupling bolts, bus bar links fit properly without any strain on any part. It shall also be checked up that lowering, lifting, racking in and out operation of the breaker and all other motions are free from any obstructions. The fixing bolts shall be grouted only after satisfying all these requirements.
53. The panels shall be checked for correct vertical position using pendulum weight and spirit levels. LT switchgear panels can be tack welded at suitable intervals for each shipping section.
54. After completion of panel erection, all the cubicles, switches, starters, CT and PT chambers, bus bar chambers shall be cleaned and checked for tightness of all the components. All loosely supplied items shall be fitted up. All the wiring connections shall also be checked with drawings and tightened. Metering and protective CTs, Alarm, indications and protective relays shall be fitted up. Phase sequence and polarity of CTs and PTs shall be checked. Contact resistance of all bus bar joints and contactors shall be checked up.
55. Any part of insulator shall be checked for any possible damage. All the starters, switches, contacts shall be cleaned. Silver tipped contacts shall never be filled or polished with sandpaper. All the moving parts shall be checked for easy and free movement. Hinges

of panel doors shall be lightly lubricated to give free and noiseless movement. All opening shall be kept completely closed to avoid ingress of any foreign particles inside the panel.

56. Individual feeder functional scheme verification shall be carried out and minor wiring modifications in the panel wiring as per requirement at site shall be done as per the directions of Engineer-in-charge. Special attention is to be paid to CT circuit's polarity, wiring continuity and correctness in the protection as well as measurement circuits.
57. Auto transfer scheme shall be simulated and verified. During the course of scheme verification, tests, any defective parts as well as functionally improper components shall be taken out after bringing to notice of Engineer-in-charge and be replaced by the component supplied by the contractor.
58. Should the switchgear be wet or having a low IR value due to bad wiring, insulators, bushings or any other insulated parts, the entire switchgear be dried up according to the instructions of the Engineer-in-charge and the IR value shall improve to a safe level for commissioning the same. Care shall be taken to protect the surrounding insulation from direct local heating during the drying up process.
59. All the metering instruments, protective relays and other relays and contractors shall be tested and cleaned as per manufacturer's recommendations (or) according to the instructions of the Engineer-in-charge.
60. All the control wiring, PT, bushing, bus bars and other live parts of the switchgear, incoming and outgoing cables shall be meggered with 500/1000V megger.
61. Electrical simulation test shall be carried out for all the protective, alarm and annunciation relays along with the manual operation of the circuit breaker.
62. Panels must be cleaned with vacuum cleaner.

E. LIGHTING SYSTEM

1. The intent of this clause is to define the requirements for the supply, erection, testing and commissioning of the lighting system. The work shall be carried out in conformity with this specification, relevant codes of practice of the Indian Standards, approved drawings and the instructions of the Engineer-in-charge.
2. The light fixtures in the common areas are fed from lighting panel and group controlled. The wiring shall be done as specified in the DBR / Drawings, all joints of conductors in Switch boards/JBS/Fitting shall be made only by means of approved Mechanical connectors (nylon/PVC connectors). Bare or twist joints are not permitted anywhere in the wiring system.
3. The lighting layouts furnished by Client/Consultant shall indicate approximate location of lighting fixtures. The electrical contractor shall determine, with approval of the Engineer-in-Charge, the exact location of each fixture in order to avoid interference with piping or other mechanical equipment and also with a view to obtain as uniform illumination as practicable, and to avoid objectionable shadow. The circuit numbering shall be provided in the drawings for the light fixtures, conduit run shall be laid out by the contractor to suit field conditions as per directions of the Engineer-in Charge.

4. Fixtures shall be firmly supported in concrete structures, where metal inserts are not available; fixtures will be fixed to or supported from concrete surfaces with the help of anchor fastener. In such cases special care shall be taken to see that anchoring is firm. For smaller weight equipment, nylon (or metallic) sleeve anchors shall be used.
5. All hardware shall be galvanized or zinc passivated.
6. Main runs of wiring from LDB and tapings to individual fixtures/sockets shall be in sizes specified on the DBR / drawings.
7. Fixtures shall be firmly supported in concrete structures where metal inserts are not available; fixtures having a weight up to 2.5 kg shall be supported by minimum two numbers nylon sleeve anchors. Flameproof or other heavier fixtures shall be supported by using metallic anchor fasteners of approved size. All supports shall be thoroughly cleaned and painted in an appropriate color to suit the fixture.
8. In case of false ceilings fixtures shall be supported from true ceiling. Exact location of fixtures shall be finalized in consultation with air-conditioning contractor and as indicated on electrical drawings. Wiring above false ceilings shall not be left loose and shall be supported along the structures/ceiling. Wiring above false ceiling shall be on surface and below false ceiling it shall be concealed. To facilitate easy maintenance looping back system of wiring shall be followed throughout. Accordingly supply tapings and other interconnections are made only at fixture connector blocks or at switch boards. Intermediate junction boxes shall be used for wire pulling as inspection boxes.
9. All wires in conduit shall be color coded. Each circuit shall have independent phase and neutral wire. Unless otherwise specified, insulated conductors of AC supply and DC supply shall be bunched in separate conduits.
10. In case of group control of light points, point to point distance shall be measured and classified for subsequent points.
11. Street lighting poles shall be installed at a distance of 300mm from the edge of the walkway of the road. Fixture wire from marshalling box up to fixture shall be 2.5mm², copper conductor PVC insulated. Main feeder up to the marshalling box shall be as per the respective drawings.
12. Each pole shall be grounded by connecting it to ground with 8 swg GI wire spring rope.
13. Street lighting shall be mounted on steel tubular poles as per standard drawings. Street lighting poles shall be supplied with a base plate and grouted. The street lighting poles shall be painted with one coat of primer and 2 coats of aluminum paint. The second coat of aluminum paint shall be given just before handing over the installation to the Engineer-in-Charge. The poles shall be numbered as per the drawings.

Light Fixtures (Luminaries) – General Requirements

14. LED luminaries shall be complete with accessories like lamps, drivers, connectors, connecting wires etc. Outdoor type fixtures shall be provided with outdoor type weatherproof box.

Lamps

15. The light fixtures and lamps shall conform to relevant standards
16. The entire lighting system will be achieved by using LED type luminaries.

17. Supply voltage 120 - 270 V AC
18. P.F > 0.95
19. High power LED's having System efficacy > 110 lm/W and junction temperature < 70°C
20. Luminaire performance complies with IS 10322 (Part 5 / Sec-3)
21. Driver surge protection 4KV, external Surge protection 10 KV with optics distribution
22. THD<10% at 110 Volts AC
23. Driver efficiency >90%
24. CCT: 3000K - 5700K, minimum CRI>70
25. The lumen output of the lamps shall be more than 105 lumens per Watt
26. The fixtures shall be with required mounting arrangements, if required to facilitate proper aiming of the luminaire at desired angle.
27. The outdoor luminaire shall be protection class IP68 for LED Module and IP67 for LED driver.
28. The light fixtures shall have complete accessories like lamps, drivers, wires between drivers and fixtures etc.

Light Control Switches

29. The switches shall be suitable for use on 240V, 1 phase, 50Hz supply; the switches shall be of flush type for mounting on an insulated plate with suitable enclosure. The switch box / enclosure may be recessed into or mounted on wall as per requirements of project layouts. The size of enclosure boxes shall be chosen to accommodate the number of switches to be installed at the particular location. The enclosures shall be made of 1.2 mm thick MS-CRCA sheet steel, stove enameled / galvanized. The enclosure box shall be with insulating cover. An enclosure intended for surface mounting shall not have holes or gaps in its sides other than those expressly provided for cable entry. The switches shall conform to the relevant standards. For common areas like corridors, car park, staircases the lighting control shall be from MCB control from DB, they need not be controlled from switches.

Receptacle Units

30. Receptacle units shall consist of socket outlet with associated switch. The socket outlet and switch or MCB shall be flush mounted within a stove enameled / galvanized 1.2 mm thick MS-CRCA sheet steel enclosure with insulating cover, the box may be recessed into or mounted on a wall as per requirements of project layouts.
31. The outdoor type receptacles shall be housed in a 2 mm thick GI enclosure with gasket, hinged door having locking arrangement. The enclosure shall be with rain canopy and removable gland plate entry for bottom, composite receptacle with switch modules housed in a box shall be with degree of protection IP 66. The receptacle units shall be suitable for 240V, 1 Phase, 50Hz/415V, 3 Phase, 50 Hz supply as indicated in project layouts.
32. Wiring for exhaust fans shall be terminated in ceiling roses/receptacles and the connection from ceiling rose/receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. The switch for control of the exhaust fan

shall be mounted at an operable height and the receptacle shall be mounted near to the fan.

Lighting Wires

33. The wires of wiring in lighting system shall be 1100V, 1 core, FRLS insulated, unarmored with stranded copper conductors. The wires shall conform to the applicable standards.

The size and no of Cu wires shall be as follows,

34. **LIGHTING:**

- DB to Switch board/First fixture - 3#2.5sqmm
- Switch board/First fixtures to Lighting point - 3#1.5sqmm
- Bay light fixtures - 3Cx2.5sqmm Ar Cu

35. **POWER SOCKET:**

- 6A (group of 6A away) - 3#1.2sqmm
- 6/16A Power sockets - 3#2.5sqmm
- Geyser sockets - 3#4sqmm
- Split-Air conditioners - 3#4sqmm
- Temporary tower AC - 3Cx4sqmm Ar Cu

36. **COLOUR CODING OR WIRES**

- R – Phase - Red
- Y - Phase - Yellow
- B – Phase - Blue
- Neutral - Black
- Earthing - Green or Yellow green

Conduits

37. Conduits and their associated fittings shall conform to applicable standards. The conduit shall be surface / concealed installation. Supply of conduits shall include all associated fittings like couplers, bends, tees, JB's, pillboxes, GI wires to pull the Cu wires etc., The following conduit sizes shall be used for surface/concealed,
- PVC conduit 20mm dia, 2mm wall thickness
 - PVC conduit 25mm dia, 2mm wall thickness
 - PVC conduit 32mm dia, 2mm wall thickness
 - MS conduit 20mm dia, 1.6mm wall thickness
 - MS conduit 25mm dia, 1.6mm wall thickness
 - MS conduit 32mm dia, 1.6mm wall thickness
38. For entire project for building concealed wiring PVC concealed conduit shall be used
39. MS conduits to be used for any surface conduit.
40. For MS Conduits only, threaded type conduit fittings shall be used. Pin Grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed with Bakelite bushings.
41. In order to minimize condensation of sweating inside the conduit system, all outlets shall be properly drained and ventilated in such a manner so as to prevent entry of insects.

42. The outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, bare threaded portion of the conduit shall not be allowed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.
43. Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side.
44. Conduit pipes shall be fixed by 16-gauge GI saddles on 25 x 6 mm GI Saddle bars in an approved manner at intervals of not more than 25 cms. Saddles shall be fixed on either side of couplers, bends or similar fittings, at a distance of 30 mm from the center of such fittings.
45. Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. The contractor shall coordinate his work with other agencies involved in the civil works in such a way that the work of these other agencies is not hampered or delayed because of any section on his part.
46. Vertical conduit runs shall be made either through columns or chases prepared in the walls. Contractor shall fill these chases or any other openings made by him after completing the work and neatly finish the surface. During installation, care shall be taken to see that adequate covers are provided to prevent rusting of conduits. If required, conduit runs may be concealed in the floor for low level receptacles.
47. After erection, the entire conduit system shall be tested throughout, for mechanical and electrical continuity and shall be permanently connected to earth by means of earthing clamps, in accordance with Indian Electricity Rules.

Outdoor Junction Boxes

48. Junction boxes with terminals shall be supplied for branching and terminating lighting cables when required for outdoor areas, terminals shall be suitable for TP N E, rating shall be in line with requirement. The junction boxes shall be dust and vermin proof and shall be fabricated from 1.2 mm to 2 mm GI sheet steel depending on the size of the junction box and shall be complete with removable cover plate with gaskets two earthing terminals each with nut, bolt and washer. Boxes shall be additionally weatherproof when specified.

MCB Distribution boards:

49. The distribution of light fixtures / receptacles shall be such that the loading on each phase of LDB is approximately equal. The loading on each circuit shall be restricted to 80% of the MCB rating and the voltage drop shall not exceed 5%.
50. Lighting Distribution Boards (LDB) shall be of sheet steel enclosed. For outdoor, canopy sloping towards rear side of the panel shall be provided to achieve a degree of protection IP-55. The lighting panels for road lighting and floodlighting of open areas shall be provided with an adjustable timer or photocell for automatically switching "ON" and "OFF" every day.

F. EARTHING SYSTEM & LIGHTNING PROTECTION SYSTEM:

- The earthing system shall be designed as per IS 3043.
- The lightning protection system shall comply with IEC 62305
- The entire earthing and lightning protection system work shall be designed based on structural earthing method.
- During execution of civil works, the earth conductors will be embedded in to concrete, and it will be interconnected / tap-off shall be made by using suitable components. The entire details are shown in the respective drawings.
- For further details like earth pit size, location, earth conductor size etc., respective layouts shall be referred.
- All electric motors, Local control stations, switchgear and other electrical equipment shall be connected to earth grid by two (2) distinct earth conductors of suitable size.
- All metallic trays, conduits, wire way and racks shall be bonded to the earth grid by earth conductors. When earth conductor passes through floor, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.
- All cable trays in the buildings as well as inside the trenches shall be connected to earth grid at an interval of about 15m. Earthing conductor running exposed on column, walls, flooring etc., shall be supported by suitable cleat.
- The earthing conductor crossing the road shall be laid in pipe sleeves or laid at a greater depth to avoid damage. Street lighting poles, flood light poles, their junction boxes shall be connected to the earthing conductor to be run along with supply cable.
- This earth conductor shall be in turn connected to earth grid at two extreme points. The cable sheaths, screens, armour shall be earthed at both ends for multi-core cables. The following sizes shall be used to carry out the earthing,
- **EARTH CONDUCTOR SIZES:**

SL NO	EQUIPMENTS	EARTH CONDUCTOR SIZES
1	MDB / MCC	50 mm X 6 mm GI Flat
2	MCB DB	8 SWG Cu wire
3	Push Button Station	8 SWG G.I. Wire
4	Motors <5kW	8 SWG G.I. Wire
5	Motors >5kW	25mm X 3 mm G.I. Flat

G. CABLING SYSTEM:

1. Cables shall be armored / Unarmored, according to the system requirement and the same is mentioned in the cable schedule.
2. All LT power cables shall be single/multi-core, 650/1100V grade, XLPE insulated. Minimum size of the power cable shall not be less than 2.5 sq. mm in case of copper and 6 sq. mm in case of aluminium.
3. Outer sheath of all cables shall be black in color. The outer sheath is to protect the cable against termite attack. Sequential marking of the length of the cable in meters shall be

- provided on the outer sheath at every one meter. The embossing shall be legible and indelible.
4. The overall diameter of the cables shall be strictly as per the standards. PVC/Rubber end caps shall be supplied for each drum.
 5. Armoured cables shall be laid underground directly in buried trenches at depth of 750mm to 1500mm as specified in the respective drawings. The cable trenches shall be prepared by earth work in excavation in all types of soils and across roads.
 6. The contractor shall carry out all the necessary shoring, strutting and bailing out water wherever required. The trenches shall be kept dry. The trench bottom shall be rammed, leveled and filled with a layer of fine 75mm thick dry cables shall be laid over it. Utmost care shall be exercised to prevent any damage to the cables while handling. The cables shall be single length without any joints in between wherever practicable.
 7. The cables so laid and tested in the trench above the sand cushion shall be covered with a layer of 200mm thick fine dry river sand. The thickness of this layer of sand shall be from the bottom of the cables. The sand layer shall be lightly pressed for consolidation, but not causing any damage to the cables.
 8. There after a protective layer of 75mm thick second-class red brick laid on flat shall be placed to cover the trenches. The remainder of the trenches shall then be back filled with the excavated soil and tamped, excess earth after back filling if any shall be disposed off as directed by the Engineer-in-charge.
 9. Bottom of trenches shall be free of large stones and foreign materials which could damage cables. A minimum total cover (sand, bricks and back fill) of 600mm shall be provided between the top of the topmost cable and grade level.
 10. A separation layer of brick shall be placed between high voltage and medium voltage cables wherever they are running in the same trench. If more than one layer of cables are laid, each layer must be separated by fine dry river sand of 200mm depth (between axis of the two layers)
 11. A minimum clearance of 300mm shall be maintained between cable trench and parallel runs of underground piping of foundation. If it is not possible the cables shall be protected in rigid steel galvanized conduits for that particular length.
 12. Cable trenches shall be identified by means of markers. These markers shall be placed at locations of changes of directions of cables and at intervals of not more than 2 meters. Such markers shall have the directional arrow for the cable from feeding plant towards connected load.
 13. Cables shall be identified with cable tag attached to each cable. The tags shall be stamped with the cable number as per cable schedule marking. Tags shall be attached to cables at minimum intervals shall be 10 meters at every straight run, starting and ends points. A minimum of 2nos of tags shall be attached to the cables inside the Distribution boards/MCC's electrical rooms.
 14. Ample stock and if necessary a loop shall be left at every straight through joint to permit re jointing at the same place.

15. Where cables rise from trench to motors, push buttons / junction boxes, etc. they shall be taken in rigid steel galvanized conduits for mechanical protection up to a minimum of 300mm above grade.
16. Minimum distance between the different types of cables viz. High voltage power cables, medium voltage power cables, copper control cables and LV cables while laying in the trenches shall be maintained as per the drawings.
17. Open cable trenches inside the buildings shall be provided with cast iron chequered plates.
18. LT cables on bottom tiers, Control and special signal cable any on the topmost tiers.
19. Cable network shall include power, control and lighting cables, which shall be laid in trenches, cable trays or pipes as detailed in the relevant drawings and cable schedules. Erection of cable trays as required shall be the responsibility of the contractor.
20. All tray levels shall be checked after erection and marked in as built drawing. Cable routing given on the layout drawings shall be checked in the fields to avoid interference with structures, heat sources, drains, piping, air-conditioning ducts, false ceiling support members etc. and minor adjustments shall be done to suit the field conditions wherever deemed necessary.
21. High voltage, medium voltage and other control cables shall be separated from each other by adequate spacing or running through independent pipes, trenches or cables trays, as applicable. All communication cables shall run on separate trays / ducts / trenches / pipes. Wherever these are not available, cables shall be taken in the same trench as that of power cable, but in a separate tray.
22. All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient length for the final connection of the cable to the terminal of the equipment. The various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables.
23. The quantity that indicated in the cable schedule is only approximate. The contractor shall ascertain the exact requirement of cable for a particular feeder by measuring at site and avoiding interference with structure, foundation, pipelines or any other services. Before the start of cable laying, cable drum schedule shall be prepared by electrical contractor and get that approved by engineer-in-charge to minimize / avoid straight through joints. Contractor shall work out the actual number of straight through joints required.
24. Cables shall be neatly arranged in the trenches / trays in such a manner so that crises crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cables within the trenches / trays shall be the responsibility of the contractor.
25. Cable routing between lined cable trench and equipment / motors shall be taken through GI pipe sleeves of adequate size. Pipe sleeves shall be laid at an angle of maximum 45° the trench wall. In case of larger dia cables i.e. 50 mm and above, adequately sized pipe with larger bending radius shall be provided for ease of drawing of cable or for

- replacement. In places where it is not possible, a smaller trench / groove may be provided if approved by Engineer-in-Charge.
26. All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted.
 27. The electrical contractor shall do removal of covers for purposes of cable laying and reinstalling them in their proper positions after the cables are laid. Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until the final termination to the equipment is completed.
 28. Cable ends shall be carefully pulled through the pipes, to prevent damage to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters pipe, the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.
 29. Following guidelines shall be adopted for sizing the pipe.

○ 1 cable in pipe	-	53% fill maximum
○ 2 cables in pipe	-	31% fill maximum
○ 3 cables in pipe	-	43% fill maximum
○ 4 cables or more	-	40% fill maximum
 30. After the cables are installed and all testing is complete, pipe ends above grade shall be plugged with a suitable weatherproof plastic compound for sealing purpose. Alternatively, G.I. Lids or PVC bushes shall be employed for sealing purposes.
 31. Where cables pass through foundation, walls or other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical contractor shall determine their location and obtain approval of the Engineer-in-Charge before cutting is done.
 32. At road crossings and other places where cables enter pipe Sleeves adequate bed of sand shall be given so that the cables do not stack and get damaged by pipe ends. Spare pipes for future use shall also be provided.
 33. Drum number of each cable from which it is taken shall be recorded against the cable number in the cable schedule.
 34. Individual cables or small groups that run along structures/walls etc. will be clamped by means of 16 SWG GI saddles on 25x6mm saddle bars. Alternatively, small group of cables can be taken through 100 mm slotted channel / ISMC 100. They shall be rightly supported on structural steel and masonry individual or in groups as required.
 35. All G.I. Pipes shall be laid as per layout drawings and site requirements. Before fabrication of various profiles of pipe by hydraulically operated bending machine (which is to be arranged by the contractor), all the burrs from the pipes shall be removed. G.I. Pipes with bends shall be buried in soil/concrete in such a way that the bends shall be totally concealed. For G.I. Pipes buried in soil, bitumen coating shall be applied on the

buried lengths. Installation of G.I. Pipes shall be undertaken well before paving is completed and necessary co-ordination with paving agency shall be the responsibility of Electrical Contractor. The open ends of pipes shall be suitably plugged with G.I. Plugs after they are laid in final position.

36. Cables laid on supporting angle in cable trenches, structures, column and vertical run of cable trays shall be suitably clamped by means G.I. Saddles / Clamps, whereas cable in horizontal run of cable tray shall be tied by means of nylon straps.
37. Cables shall be uniformly spaced, properly supported and protected in an appraised manner. All bends in runs shall be with due consideration to avoid sharp bending and kinks of the cables. The bending radius of various types of cables as per IS: 1255 shall not be less than those specified **
38. Type of cables and Minimum Bending radius

○	Voltage grade	single core	multi core
○	1.1 kV PVC	15 D	12 D
39. Where cables are required to cross roads and surface drains they shall be taken through Hume pipes at a depth mentioned in the respective drawings.
40. Where cables are required to be laid inside the building they shall be taken through PVC pipes at a depth mentioned in the respective drawings.
41. Where cables are required to be laid inside the building on surface, they shall be taken through GI conduits.
42. For crossing water, sewage pipes etc. cable shall be taken through pipes shall be placed in such a manner that the distance between top or bottom of service pipes shall be 250 mm minimum.

CABLE TERMINATION:

43. All PVC cables upto 1.1 kV grade shall be terminated at the equipment by means of single compression type cable glands. They shall have a screwed nipple with conduit electrical threads and check nut.
44. Power cables wherever colour coding is not available shall be identified with red, yellow and blue PVC tapes. Where copper to aluminium connections are made, necessary bimetallic washer shall be used. For trip circuit identification additional red ferrules shall be used only in the particular cores of control cables at the termination points in the switchgear/Control panels and Control Switches.
45. In case of control cables their terminal numbers by means of PVC ferrules or self-sticking cable markers shall identify all cores at both ends. Wire numbers shall be as per schematic/wiring/ inter-connection diagram. All unused spare cores of control cable shall be neatly bunched and ferruled with cable tag at both ends.
46. Where threaded cable gland is screwed into threaded opening of different size, suitable galvanized threaded reducing bushing shall be used of approved type. Contractor shall drill holes for fixing glands wherever necessary. Gland plate shall be of non-magnetic material 3mm sheet steel.
47. The cable shall be taken through glands inside the panels or any other electrical equipment such as motors. The individual cores shall then be dressed and taken along

the cableways (if provided) or shall be fixed to the panels with polyethylene straps. Only control cables of single strand and lighting cables may be directly terminated on to the terminals.

48. Cable leads shall be terminated at the equipment terminals, by means of crimped type soldieries connectors. Crimping shall be done by hand crimping / hydraulically operated tool and conducting jelly shall be applied on the conductor. Insulation of the leads should be removed immediately before the crimping. Conductor surface shall be cleaned and shall not be left open.

CABLE TESTING:

49. Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground.
50. Where splices or termination are required in circuits rated above 600 volts., measure insulation resistance of each length of cable before splicing/terminating.
51. Measure the insulation resistance of directly buried cable circuits before cable trenches are back-filled. Repeat measurement after back filling. For cables upto 1.1kV grade, 1000V megger and for HV cables 2.5 / 5kV megger shall be used.
52. D.C. High Voltage test shall be conducted after installation on the following and test results shall be recorded.
53. For record purposes test data shall include the measured values of leakage current verses time. The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer-in-Charge.
54. Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgears, transformers etc. are not subject to test voltage.
55. Cable schedule and layout drawings must be marked for AS BUILT conditions during the installation work and shall be approved by Engineer-in-charge.

H. DATA/TELEPHONE/TV SYSTEM:

1. The Multipurpose Sports Block is provided with adequate number of data/ telephone / TV / CCTV points. The exact number of points shall be obtained from respective layouts.
2. The field cabling shall be done with CAT6A
3. The backbone shall be by 2core FOC
4. The camera shall employ complete solid-state circuitry, ensuring high operational reliability.
5. Network bullet camera, it shall be IR Indoor type 1by3 inch CMOS 1point 3 MP 2 point 8 mm Fixed 12 IR LEDs PoE H point 264
6. Network bullet camera, it shall be IR outdoor type 1by3 inch CMOS 1point 3 MP 2 point 8 mm Fixed 12 IR LEDs PoE H point 264
7. The NVR shall be 32 Chanel with all connected accessories.

I. SAFETY ITEMS SCHEDULE:

SN	DESCRIPTION	UNIT	QTY
Supply and installation of the following equipments per electrical room:			
1	12 mm thick 900mm width Non-skid rubber mat for 1.1KV grade	Mtr.	LOT
2	Sand bucket painted red & approved quality with MS stand to fix 4 buckets (1sets of 4 buckets).	Set	1
3	Danger plates 440 volts written in two languages.	No	2
4	Carbon dioxide fire extinguisher type 4.5 kg capacity.	No	2
5	Standard first aid box kit.	No	2
6	Shock treatment chart written in two languages.	No	2

..... **END OF ELECTRICAL TECHNICAL SPECIFICATION.....**

SPECIAL CONDITIONS OF CONTRACT AND SPECIFICATIONS FOR HVAC WORK (VENTILATION)

SPECIAL CONDITIONS OF CONTRACT

1.0 GENERAL

These special conditions are meant to amplify the specifications and General Conditions of Contract. If any discrepancy is noticed between these conditions, General Conditions of Contract, Specifications, Bills of Quantities and Drawings, the most stringent of the above shall apply for execution of the work.

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 instruction/ directions of Construction Manager will be binding on the contractor.

The scope of this section is to describe materials and systems for complete HVAC works of building which form together with the project documents, a complete volume of work and quality description.

HVAC Works installation shall be of high quality, safe, complete and fully operational including all necessary items and accessories whether or not specified in detail. All specified work shall be completed in accordance with the regulations and standards to the satisfaction of the Construction Manager/Consultants and as per Inspectorate or Local Authority's requirement. The general provisions, special provisions and general requirements apply to the entire installation.

2.0 SCOPE OF WORK

The scope under this contract shall include the HVAC works installation for the project. The work to be carried out under this contract shall cover the supply, installation, testing and commissioning of works shown in the drawings and specifications.

In general, the work to be performed under this contract shall comprise of the following:
Supply, installation, testing & commissioning of HVAC Works.

Contractor shall carry out and complete the said work under this contract in every respect in conformity with the current rules and regulations of the local statutory authority. The contractor shall furnish all labour and install all materials, appliances, equipment (except those items which will be supplied by the Owner to the contractor at site), necessary for the complete provision and testing of the HVAC works as specified herein and shown on the drawings. This

also includes any materials, appliances, equipment not specifically mentioned herein or noted on the drawings as being furnished or installed but which are necessary and customary to make complete installation shown on the schedule and described herein, properly in working condition.

The work shall include all incidental jobs connected with HVAC work installation such as cutting/drilling and grouting for fixing of MS Channels, equipment, making good the damages etc.

If any breakage of finished walls or floors are done after the other agencies completed their work, HVAC contractor shall bear all expenses towards redoing & finishing the same to the satisfaction of Construction Manager/Consultants.

The tenderer should give detailed heat load calculations as per format given in technical specifications for all the seasons in which the specified conditions are to be maintained.

The equipment selection shall be applicable as per heat loads only in case if it the capacity of equipment required as per heat load calculation will be more than equipment capacity given in tender.

3.0 APPROVAL BY STATUTORY BODIES

The complete HVAC equipment installation shall be in conformity with the Tender Specification and shall comply with the statutory regulations and requirements. Contractor before the award of work shall immediately bring to the notice of Construction Manager, any item not in compliance with statutory regulation. He shall be responsible to obtain the approval of the drawings and installation from the local statutory bodies.

4.0 SHOP/ WORKING DRAWINGS

On the award of the work, the Contractor shall immediately proceed with the preparation of detailed working/ shop drawings showing the detail of the equipment that are to be installed and the ancillary works that are to be carried out.

Three sets of all such working/ Shop drawings dully signed by the head of the planning & design department shall be submitted to the Owner / Consultant / Architect 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 Owner / Consultant / Architect for approval within 04 (Four) weeks of the award of work. The approval of the drawings by the Owner / Consultant / Architect shall in no way relieve the Contractor from his obligations to provide a complete and satisfactory plant installation, testing and commissioning as per intent and purpose as laid down in the specifications.

Any omissions and / or errors shall be made good or rectified whether or not the drawings are approved. Contractor shall obtain written approval for samples (like grills / diffusers) and other materials before placing the order. Contractor shall guarantee the specified inside conditions at specified outside conditions. Prior to the completion of the work, the contractor shall furnish

to the employer (7) seven sets of a comprehensive manual, describing all components furnishing a list of spare parts and setting forth in details the instructions for the operation and maintenance of the plant.

The Contractor shall also fix in the plant room, neatly typed and framed, instructions in details, for the starting and running of the plant.

The following shop/ Working drawings shall be prepared by the AC contractor for approval-

- a) Layout drawings including sections of the equipments to be installed in various rooms such as plant room, AHU rooms, cooling tower and other equipments.
- b) Schematic chilled Water Piping schematic VRV piping drawings.
- c) Duct layout plans showing sizes, locations of dampers, grilles & diffusers of all floors including AHU rooms.
- d) Plumbing drawings showing the layout of entire piping, dia. & length of pipes, valves and isometric drawings showing connections to various equipments.
- e) Ventilation layout plans for basement floors, AC Plant Room, DG Room, Toilets, Lift well & staircase pressurization etc.
- f) Electrical panel, sub panels, power & control wiring drawings.
- g) Foundation details of all equipments.
- h) Drawings showing the details of all insulations and vapour barrier works, supports for pipes, cable trays, ducts etc.
- i) Drawings including section, showing the details of erection of entire equipments including their foundations, water basin for the cooling towers / air washers, etc.
- j) Any other shop/ Working drawings necessary for the project.

5.0 CO-ORDINATION WITH OTHER WORKS

The Contractor during the execution of the Works shall co-ordinate with other Works, and other Agencies associated with the Project and shall work in harmony with them without causing any hindrance or obstruction or impeding the progress of their work in any way. Shafts/cutouts (sizes) confirmation that specified can be accommodated within the available size of shafts etc.

In respect of the work of other Services and Agencies, where the commencement or progress of such work of any other Service, or Agency is dependent upon the completion of particular portions of the Contractor's Works or generally upon the Contractor maintaining progress in accordance with the approved coordinated construction programme, it shall be the responsibility of the Contractor to complete such portions and maintain such progress.

Should any differences arise between the Contractor and the other Works, and Agencies, these shall immediately be brought to the attention of the Construction Manager/Consultants who after reviewing the matters causing the differences will give his decision which shall be final and binding on the Contractor.

5.1 CO-ORDINATION WITH FIRE PROTECTION SYSTEM WORKS

To collect all relevant information regarding contracts etc. for the operation condition of HVAC under fire conditions.

5.2 CO-ORDINATION WITH CIVIL WORKS

To prepare detailed shop/ working drawings for related works in accordance with the civil construction drawings.

5.3 CO-ORDINATION WITH ELECTRICAL, PHE WORKS

To co-ordinate all relevant information regarding power and exact location of panels.

5.4 CO-ORDINATION WITH BUILDING AUTOMATION AND SECURITY SYSTEM WORKS

To co-ordinate & provide all the relevant information to the Building Automation and Security System Works.

6.0 PERFORMANCE BOUND CONTRACT

The contract will be a performance-bound contract and therefore the Bidder shall make their independent check for Heat Load, selection of equipments etc. The drawings enclosed with the tender documents shall be only tentative layout plans and for guidance purpose only. The detailed shop drawings shall be prepared and submitted for approval to the Owner/ Consultant/ Architect.

The contractor shall guarantee the specified inside condition at specified outside condition considering the fresh air as detailed in the basis of design of the tender documents.

The contractor shall guarantee the HVAC system shall be provided with suitable Vibration isolators and controls and noise control.

7.0 GUARANTEE

The contractor shall guarantee the complete AC system for a period of 12 months from the date of successful handing over the plant after successful initial testing & one major seasonal test i.e. either summer or monsoon to the department. The Tenderer shall guarantee the AC system to maintain space conditions as specified in Basis of Design. They shall also guarantee that the performance of the various equipments individually or jointly shall be within $\pm 3\%$ of the specified ratings when working under operating conditions for the complete installation.

During guarantee period loss of refrigerant and oil, if any shall be borne by the air-conditioning contractor. De-scaling, if required during the guarantee period, shall be done by air-conditioning contractor free of cost if certified by OWNER.

8.0 REPAIRS / REPLACEMENT OF PARTS DURING GUARANTEE

Any defects or other faults which may appear within defect liability/ guarantee period of 12 months from the date of handing over the plant in a satisfactory working condition to the Client (except for normal wear and tear) arising in the plant from material or workmanship not in accordance with the contract specification will be rectified by the contractors free of cost & nothing shall be paid extra on any account.

9.0 TOOLS, TACKLES, EQUIPMENTS & SCAFFOLDING

All tools, tackles & equipments necessary for the HVAC installation and testing shall be provided by the contractor. The quoted rates shall take into account for providing any such equipment, which may not form part of the installation, but are necessary for the execution of the job. Contractor shall be responsible to make his own arrangement to provide scaffolding/ support etc., necessary for his work. However, the contractor may use the civil contractors scaffoldings if available with prior understanding with the civil contractors.

10.0 DRILLING/CUTTING

The contractor shall have to do all drilling and cutting of walls or other elements of the building for the complete and proper installation of the conduits, and other equipments etc. by using electrically operated tools. Manual drilling or chiseling shall be permitted on special request only.

Beams, girders and other principal structural members shall not be cut or drilled unless prior permission has been granted by the Construction Manager/Consultants.

If such drilling and cutting are made on finished surfaces, any marring of the surfaces shall be made good by repair at the HVAC contractor's expense.

11.0 PLASTERING OF WALL CHASES/OPENING ETC.,

All chases and openings made by the contractor for his conduits, boxes etc., shall be filled/covered over with cement plaster in reasonable manner, to be finished by the civil contractor.

Before rough plastering on the conduit surface the concealed conduits shall be secured to the wall by using saddles and nails.

12.0 MANUFACTURERS

Where manufacturers have furnished specific instructions relating to the materials used in this job, covering points not specifically mentioned in these documents, these instructions shall be followed in all cases.

Where manufacturer's names and/or catalogue numbers are given, this is an indication of the quality, standards and performance required.

For items not covered under the List of Approved Makes', contractor shall offer items of first-class quality, standards and performance and obtain the approval of Construction Manager/Consultants before procuring them.

Where interfacing occurs, equipment shall be mutually compatible in all respects.

13.0 RATING

Rating of all items shall be appropriate for the conditions on the particular site on which the item will be used. All the equipment shall be fit for continuous work under the most severe weather conditions of site.

14.0 INSPECTION AND TESTING

The Construction Manager reserves the right to request inspection and testing at manufacturer's works at all reasonable times during manufacture of items for this contract. Tests on site of completed works shall demonstrate, among other things:

- a) That the equipment installed complies with specification in all particulars and is of the correct rating for the duty and site conditions.
- b) That all items operate efficiently and quietly to meet the specified requirements.
- c) That all circuits are correctly protected and that protective devices are properly coordinated.
- d) That all non-current carrying metal parts are properly and safely grounded in accordance with the specifications and Codes of Practice.

The contractor shall provide all necessary instruments and labour for testing, shall make adequate records of test procedures and readings, shall repeat any tests requested by the Construction Manager/Consultants and shall provide test certificates signed by a properly authorized person. Such test shall be conducted on all materials and equipment and on completed work as called for by the Construction Manager/Consultants.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification and retesting of the same as called for by the Construction Manager/Consultants at the cost of the contractor. The Construction Manager/Consultants decision as to what constitutes a satisfactory test shall be final.

The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Construction Manager/Consultants.

All testing instruments, velocity meter, digital thermometer, psychrometer, measuring steel tapes, tools, scaffolding and ladders etc. that may be required for taking measurements shall be

arranged by air-conditioning contractor at his own cost.

All types of routine and other tests shall be carried out at the works of the Contractor or the manufacturers of the components. The Client shall be free to witness any or all tests, if they so desired. The Contractor has to inform to the Client before dispatch of any material / equipment.

On the completion of the installation the Contractor shall arrange to carry out various initial tests as detailed below, in the presence of Owner / Consultant / Architect and to the entire satisfaction of the Owner / Consultant / Architect. Any defect or shortcoming found during the tests shall be speedily rectified or made good by the Contractor at his own expenses. During Fire Ventilation Test by the Fire Department the AC contractor shall arrange & stand to carry various in initial Test such as Normal operation & In case of Fire.

The initial tests shall include, but not be limited to the following:

To operate and check proper functioning of all electrically operated components viz. Compressor motor, pumps, fan of air handling units etc. as well as other electrical motors.

To test and check the proper functioning of electrical gears, safety and other controls to ensure their proper functioning.

To check the air distribution system and to provide designed air flow in all areas by adjusting the grills, diffusers and dampers for air-conditioning.

To check & balance / adjust the water in the water circuit for smooth and noiseless flow.

To check the systems against leaks in different circuits, alignment of motor, 'V' belt adjustments, control setting and all such other tests which are essential for smooth functioning of the plant.

Contractor shall have to submit the capacity test of all equipment at site.

On the satisfactory completion of all 'Initial' tests & one major seasonal test i.e. either summer or monsoon the plant shall be considered 'Virtually Complete' for the purpose of taking over by the Client.

In addition to the 'Initial' test the Contractor shall also give summer, monsoon & winter tests of the plant, each of (3) three days duration, and each one during the full specified outside conditions (when the ambient conditions are close to the specified ambient conditions). The first running test may be taken on the completion of the initial test, provided the ambient temperature and humidity are near their peak. Inside condition as per the contract, performance of each equipment, Airflow etc. shall be as per the requirement of the contract during these tests.

It is clarified that guarantee period shall start after successful completion of one major test i.e.

either summer or monsoon for all equipments & inside temperature in the working area if any.

15.0 TEST CERTIFICATES

The contractor shall submit test certificates for all the major equipments. Type tests shall be carried out as per relevant standards issued by Bureau of Indian Standards. For other items, such test certificates issued by Government recognized inspection office certifying that all equipment, materials, construction and functions are in compliance with the requirements of these specifications and accepted standards of BIS/International standards.

16.0 SAMPLES AND CATALOGUES

Before ordering the material necessary for these installations, the contractor shall submit to the Construction Manager/Consultants for approval, a sample of every kind of material such as grilles, diffusers, cables, ducting, insulation, pipes, valves etc., along with the catalogues with their dimensional details.

17.0 AS BUILT DRAWINGS

At the completion of work and before issuance of certificate of virtual completion the contractor shall submit three (07) sets of following drawings to the Engineer-in-charge, layout drawing drawn at appropriate scale indicating the complete HVAC system “as installed”. Out of this one of the sets shall be laminated on a hard base for display in the A.C. Plant room. In addition, one set will be given on compact disc.

- a) Plant installation drawings giving complete details of all the equipments, including their foundations.
- b) AHU room installation drawings.
- c) VRV installation drawings.
- d) Plumbing layout drawings, including insulation giving sizes and lengths of all the pipes and the sizes and locations of all types of valves, and including isometric drawings for the entire piping including the pipe connections to the various equipments and insulation details wherever required.
- e) Duct layout drawings with their sizes and locations, and sizes and locations of all dampers, grilles & diffusers.
- f) Line diagram and layout of all electrical control panels giving switchgear ratings and their disposition, cable feeder sizes and their layout.
- g) Control wiring drawings with all control components and sequence of operations to explain the operation of control circuits.

18.0 INSTRUCTION/MAINTENANCE MANUAL

The Contractor shall prepare and produce instruction, operation and maintenance manuals in English for the use, operation and the maintenance of the supplied equipment and installations and submit to the Construction Manager/ Consultants in (7) copies at the time of handing over.

The manual shall generally consist of the following:

- a) Description of the project.
- b) Operating instructions.
- c) Maintenance instructions including procedures for preventive maintenance.
- d) Manufacturers catalogues.
- e) Spare parts list.
- f) Trouble shooting charts.
- g) Drawings.
- h) Type and routine test certificates of major items.
- i) One (1) set of reproducible 'as built' drawings.

19.0 COMPLETION CERTIFICATE

On completion of the installation a certificate shall be furnished by the contractor countersigned by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local statutory authority. The contractor shall be responsible for getting the installation inspected and approved by the local concerned authorities and for obtaining the necessary clearance certificates from the authorities.

20.0 SUPERVISION

The contractor shall employ competent fully licensed qualified, full-time engineer at site with minimum 10 years experience to direct the work of HVAC works installation in accordance with the drawings and specifications. The engineers shall be available at all times at site to receive instructions from the Construction Manager, in the day-to-day activities throughout the duration of contract. The engineer shall correlate the progress of the work in conjunction with all the relevant requirements.

21.0 CODES AND STANDARDS

Any other codes or standards which are required but not mentioned in the technical specs should be considered as per the latest Indian standards & international standard in case of absence of Indian standard.

22.0 CONTRACOTRS TO PROVIDE

All the materials including installation, testing and commissioning.

23.0 OPERATION OF PLANT

The tenderer shall arrange to operate the plant for a period of ONE MONTH from the date of commissioning of plant and successful completion of initial test free of cost.

24.0 TECHNICAL DATA

All technical data to be filled by the bidders in technical specs shall be accepted in metric system only. Any bidder submitting the technical data in any other unit would render his bid liable for rejection. The technical data should be typed in capitals only.

25.0 TRAINING OF PERSONAL

The contractor shall impart training to the minimum three technical staffs appointed by the Client free of cost during erection and commissioning of the plant.

I SPLIT SYSTEM AIR CONDITIONERS**1. General:**

The contractor shall supply and install split system air conditioners wherever indicated. The system shall be complete in all respects and comply with the specifications as given.

2. Indoor Units

The indoor units shall be complete in all respects and shall generally comply with the specifications as given in the following paragraphs.

2.1 High Wall Mounted Units:

The units shall be High wall mounted type. The housing of the unit shall be of powder coated galvanised steel and shall include pre filter, fan section, coil section, etc. The body shall be light in weight.

The fan shall be Aerodynamically designed diffuser turbo fan type. The fan shall be mounted directly on motor shaft having supported from housing. The fan shaft shall be statically and dynamically balanced. The fan shall be direct driven type.

The cooling coil shall be of seamless copper tubes and shall have continuous aluminium fins. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes. The coils shall be tested against leaks.

Unit shall have filter cleanable type of resin net (with mold resistant) fixed to an integrally molded plastic frame. The filter should be slid away type but neatly inserted.

2.2 Control:

Each unit shall be with corded remote controller to operate maintain inside conditions.

2.3 **Testing:**

The indoor unit shall be tested to measure air quantity and coil performance by measuring temperature difference and then calculating the capacity.

3. **Refrigerant Piping:**

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

All joints in copper piping shall be swaged joints using low temperature brazing and/or silver solder. Before joining any copper pipe or fittings, its interior 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 construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to less than 0.2 kg per Sq.cm.

After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen at a pressure of 20 Kg per Sq. cm. (High side) and 10 Kg per Sq. cm (Low side) pressure shall be maintained on the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm. of mercury and held for 24 hours, during which time change in vacuum shall not exceed 12 cm of mercury. Vacuum shall be checked with vacuum gauge.

All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers.

4. **Miscellaneous:**

- 4.1 The unit shall have control panel, housing the starting switches, contactor, relays etc.
- 4.2 Isolation pads shall be provided under the units.
- 4.3 Drain line shall be provided from fan coil unit upto drain trap. (To be priced separately).
- 4.4 Ductable unit shall have canvass connection at its outlet. The canvass connection shall be fire retardant, nonporous double layer.
- 4.5 Suitable M.S. angle iron supporting frame shall be provided for the condensing unit and supporting arrangement for the indoor units.
- 4.6 Interconnecting power and control cabling shall be provided between condensing unit and evaporator unit.

5. **Power Supply:**

Power supply near the indoor unit will be provided by the Electrical sub-contractor with suitable MCBs.

From MCB to indoor unit and outdoor unit to Indoor unit by the contractor along with earthing.

II VENTILATION SYSTEM

1. General:

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

2. Exhaust Fans (Propeller Type):

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

3. Exhaust Fans (Vane/Tube Axial flow type):

Axial flow fan shall be of vane/tube axial type and shall be suitable for mounting in duct or floor/slab as required/indicated on the tender drawings. Fan performance shall be based on tests conducted in accordance to AMCA 210 for air performance and AMCA 300 for Inlet sound power levels. These fans shall be licensed to bear the AMCA seal for air and sound performance.

3.1 Impellers:

Single piece cast aluminum or steel impeller shall be with blades of aerofoil design to give maximum efficiency and shall vary in twist and width from hub to tip to effect equal air distribution along the blade length. Single piece fan and hub shall be statically and dynamically balanced. Maximum clearance between blade tip and the fan housing at the specified speed shall be 5 mm. Impellers blades shall be whirl tested to a speed 25% above the design operating speed. Extended grease leads for external lubrication shall be provided. The fan blade shall be adjustable type so that actual air flow can be achieved at site as per indicated in Drawings & BOQ.

3.2 Casing:

Casing shall be constructed of 14-gauge sheet steel, properly reinforced for rigidity. Fan casing, motor mount and straightening vanes shall be of welded steel construction motor mounting plate shall be minimum 20 mm thick and machined to receive motor flanges.

Casing shall be provided with two nos. wide, hinged doors which open easily. Inspection doors with handle and neoprene gasket shall be provided. Casing shall have flanged connection on both ends for ducted applications. Support brackets for ceiling suspensions shall be welded to casing for connection to hanger bolts. Straightening vanes shall be aerodynamically designed

for maximum efficiency by converting velocity pressure to static pressure potential and minimizing turbulence. Casing shall be bondorized, primed and finish coated with enamel paint.

3.3 **Motor:**

Motor shall be squirrel cage, totally enclosed, fan cooled, constant speed, suitable for $415 \pm 10\%$ volts, 50 Hz, 3 phase power supply, motor nameplate horsepower shall be more than brake horsepower by a minimum of 10%. Motor speed shall not exceed be 2900, 1500, 975, or 750 rpm in 50 Hz with suitable service factor. The fan and motor combination selected for particular requirement shall be of the most efficient type so that sound level and energy consumption is minimum. Motor conduit box shall be mounted on exterior of the casing. Wires from the motor to the conduit box shall be protected from the air stream by enclosing in a flexible metal conduit. The motor shall have 'H' class insulation wherever mentioned in BOQ. Motors must be standard IEC and corresponding Frame designs that are readily available from motor vendors. Suppliers using C-Face or Pad Mount motors must include provisions to provide replacement motors in case of a motor failure due to long motor lead times. Motors for emergency smoke/ fire ventilation shall use insulation class H and shall be UL Listed or EN Certified, as noted below: 250°C for a minimum of 2 hours of operation with class H insulation. Each fan shall be direct driven in AMCA arrangement 4 with propeller secured to the motor shaft. All fans which have to run in case of smoke exhaust, Fan manufacturer shall submit "certificate of conformity for 250 deg C for 2 hours operation as per EN12101-3: 2002 issued by internationally recognized independent fire laboratory. The make of motor used during the testing and the make of motor supplied by the fan manufacture at site should be same.

3.4 **Drive:**

- **For Duct/Wall Mounted Fan:**

For duct/wall mounted fans the impeller shall be mounted directly on the motor. Drive unit and impeller shall be totally enclosed inside the duct.

- **For Floor/Ceiling Mounted Fan:**

The fan shall be provided with belt drive and adjustable motor sheave, standard sheet steel belt guard with vented front for heat dissipation. Belt shall be of the oil-resistant type.

- **Vibration Isolation:**

Base shall be provided for each fan. Base for both fan and motor shall be built as an integral part and shall be mounted on a concrete foundation through spring type of vibration isolators. The concrete foundations shall be at least 15 cm above the finished floor level and shall be further isolated from the structural floor through 5 cm. Thick layers of sand all around, topped with bitumen. In case ceiling hung fan within the ceiling shall be provided Vibration Isolation Suspension (VIS) shall be provided in each of string.

4. **Centrifugal Blowers:**

4.1 The centrifugal blowers shall be double/single inlet, double/single width, non over loading

type, be suitable construction. The blower performance must be rated in accordance with approved test codes and procedures as per IS: 4894-1987 code of practice for centrifugal fan.

- 4.1.1 Housing shall be of heavy gauge sheet steel in welded construction. It shall be rigidly reinforced and supported by structural angles. Split casing shall be provided on larger sizes of fans. However, neoprene/ asbestos packing shall be provided throughout split joints to make it airtight. 1.2 mm galvanized wire mesh inlet guard of 5cms sleeves shall be provided on both inlets. Housing shall be provided with access door with quick-locking tension handles and neoprene gasket. Rotation arrow shall be clearly marked on the housing.
- 4.2 The blower housing comprising of scroll & side plates shall be accurately cut, heavy gauge all welded sectional construction and reinforced with angle bracing. Outlets shall be flanged to assure proper duct connections. Inlet cones shall be spun venture type or curved vane type to ensure smooth air entry. The base frame shall be of angle iron in bolted/welded construction.
- 4.3 Impeller shall be fabricated from sheet steel with backward curved, properly designed. Blades, heavy C.I. hub and shall be both dynamically and statically balanced, to a close tolerance for quiet and vibration free performance.
- 4.4 Shaft shall be hot rolled steel or forged steel, sized adequately, but in no case less than 40 mm diameter and shall be accurately ground and polished to a close tolerance.
- 4.5 Bearings shall be self aligning, heavy duty ball or tapered roller type with integral dust and grease seals. Bearings shall be of the sleeve/ball bearing type mounted directly on the fan housing.
- 4.6 After assembly, the complete fan shall be painted with rust proof primer and two coats of synthetic enamel paint.
- 4.7 Fan having wheel diameter of 1220 mm or more, shall be supplied with split, bolted housing for convenience of handling and installation.

5. **Blower Drive Assembly:**

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

6. Motors and Starters:

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

7. Accessories:

All necessary accessories shall be provide for proper operation and shall also include:

- 7.1 Vibration isolators for the blowers.
- 7.2 Double canvas connections at the outlet of each fan.
- 7.3 Nuts, bolts, shims etc. as required for the grouting of the equipment.
- 7.4 Slide rails for mounting the motor and belt adjustments.

8. Fresh Air and Exhaust Air Fan Sections:**8.1 Housing:**

Housing of fan section shall be of weatherproof double skin construction. The framework shall be of extruded aluminium hollow section. All the frames shall be assembled using pressure dye cast aluminium joints of various sections, strong and self-supporting framework of various sections. The double skin panels shall be 25 mm thick and shall be made of 0.6 mm pre-painted GSS sheet on outside and 0.6 mm plain GSS sheet on inside with CFC – FREE P.U. insulation of 40 (+/- 5%) kg/Cu M injected in between by injection moulding machine. These panels shall be screwed on to the framework with soft rubber gasket in between to make the joints airtight. Suitable air-tight access doors with hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on extruded aluminium channel framework having pressure dye cast aluminium joints.

8.2 Fan Section

The fan shall be forward/backward curved double inlet, double width type. The wheel and housing shall be fabricated from heavy gauge galvanized steel. The impeller and fan shall be statically and dynamically balanced. The fan shall be selected for a speed not exceeding 1000 RPM. Frame housing with motor shall be mounted on a common extruded aluminium base mounted inside the housing on anti-vibration mounds. Fan outlet shall be connected to casing with the help of fire-retardant fabric acting as flexible connection for anti-vibration. The manual dampers shall be installed at the outlet of the unit. The damper should be air-tight and should be in a position to prevent back flow. Velocity at blower outlet shall not exceed 10 m/sec (2000 FPM).

8.3 **Blower Drive Assembly:**

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

8.4 **Filter Section (Not applicable in Exhaust air fan sections) :**

The unit shall be provided with factory assembled filter section containing washable air filter having bounded expanded aluminium media with frame. The filter media and frame shall be rust proof and corrosion resistant. The filter shall be fitted so as to prevent by-pass and it shall be possible to remove the filters easily. Average velocity across fresh air fan section filters shall not exceed 2.5 m/sec (500 FPM).

Each unit shall have standard filter 50 mm thick having 5 layers of Aluminium wire mesh having an efficiency of 80% for 20micron dust.

8.5 **Motors and Starters:**

- 8.5.1 The motor for each blower, shall be squirrel cage induction type and conform to specifications as given under section on control panel, motors and switchgear. The motor H.P. shall be at least 20% more than the limit load of fan. The fan motor shall be suitable for $415 \pm 10\%$ volts 50 cycle 3 phase squirrel case totally enclosed fan cooled with IP 55 protection. The motor speed shall not exceed 1450 rpm. The drive to the fan shall be provided through belt arrangement. **The Fan motor shall be energy efficient with efficiency level of IE-3.**

8.6 **Accessories:**

All necessary accessories shall be provided for proper operation and shall also include:

- 8.6.1 Vibration isolators for the blowers.
- 8.6.2 Canvas connection at the outlet of each fan.
- 8.6.3 Nuts, bolts, shims etc. as required for the grouting of the equipment.
- 8.6.4 Slide rails for mounting the motor and belt adjustments.

8.7 **Limitation:**

- 8.7.1 The air velocity limits are as follows: -
- 8.7.2 Velocity across filter - not exceeding 2.5 mtr./s (500 FPM).

8.7.3 Velocity at blower outlet - not exceeding 10 mtr./s (2000 FPM).

9. **Inline Fans**

9.1 **General:**

The Inline fans shall be complete in all respect and shall comply with the following specification.

9.2 **Inline Fans:**

The fan shall be complete with centrifugal impeller, casing, direct driven motor, vibration isolators.

9.2.1 **Housing**

The 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. The housing shall indicate arrow showing rotation, make, model and duty conditions.

9.2.2 **Fan Wheel**

Fan wheel shall be forward/backward curved type, fan wheel shall be statically and dynamically balanced.

9.2.3 **Ball Bearing**

The ball bearing shall be completely maintenance free and can be used in any mounting position, at maximum indicated temperature. The bearing lubricant shall be suitable for a minimum ambient temperature of minus 15^o C. For application at maximum indicated ambient temperature, life expectancy L₁₀ is 40,000 hours minimum.

9.2.4 **Fan Motor**

Fan shall be supplied with built in Thermal contact (TK). At the critical high temperature point ('B' = 130 C or 'F' = 155^o C) the Thermal contact will open and break the power supply to the fan. Fan motor shall have insulation class 'B' or class 'F' and protection class IP44 or IP54.

9.2.5 **Fan Drive**

The fan shall be direct driven type.

10. **Painting:**

The complete fan assembly, casing and other steel structure shall either be GSS or epoxy panted as per IS 5 : 1994 specification for ready mixed paints and enamels.

III CONTROL PANEL, MOTORS AND SWITCHGEARS

1. General:

- 1.1 The motor and switchgears required for various items shall generally be as per specifications given below. All electric motors shall be suitable for 3 phase, 50 Hz, 415 + 10% - 15% Volts A.C. supply.

2. L.T. Electric Panel Boards:

- 2.1 The main L.T. Panel board shall be extendible type on both sides, having in it all switches, starters & accessories and shall be completely factory prewired. It shall be suitable for voltage systems upto 500 volts, 3 phase, 50Hz, 4 wire supply capable of functioning satisfactorily in temperatures of 45⁰C and rupturing capacity not below 31 MVA at 415 Volts.
- 2.2 The boards shall be fabricated from 2.0 mm thick, cold rolled M.S. Sheets. The front opening door panels shall be from 2 mm thick, cold rolled M.S. Sheets. Suitable stiffeners shall be used in fabricating the housing. All steel members shall first be degreased, then descaled using dilute sulphuric acid and a suitable phosphating process then the boards shall be given 2 coats of red oxide primer with powder coated finish in siemens grey colour. The switchboard shall be dustproof and vermin proof. The panel shall generally conform to IS 8623 (full conformity not called for). It shall be flush in front and back. The panel shall have front and rear access.
- 2.3 Cable compartment of adequate size shall be provided in the main distribution board for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate support shall be provided in cable compartment to support cables. All incoming and outgoing switch terminals shall be brought out to terminal blocks in cable compartments.
- 2.4 Items such as ammeters, switches etc. shall be located close to the corresponding switchgear and otherwise all items shall be arranged in a neat symmetrical pattern.
- 2.5 The doors of the switch compartments and cable access shall be hinged type and that of busbars shall be fixed type.
- 2.6 The knobs of the hinged doors shall be provided with a locking arrangement to prevent them from falling down when they are unscrewed for opening the doors.
- 2.7 All panel doors shall have synthetic rubber gaskets with good ageing, compression and resistance characteristics.
- 2.8 All the breakers shall be interlocked with door so that the unit cannot be closed unless the unit door is closed. The interlock shall also prevent opening the unit door unless the switch/breaker is in OFF position.
- 2.9 Defeat arrangement shall be provided for deliberate inspection of switch/breaker without having to switch OFF the unit.

-
- 2.10 All the units pertaining to a motor shall be incorporated in one cabin i.e., switch, starter, CTS ammeter, current operated MPRD-2 single phasing preventor, indicating lamps etc.
 - 2.11 A danger notice plate of 200 mm x 150 mm of mild steel at least 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side shall be provided on the panel board.
 - 2.12 Every starter/contactors etc. shall be controlled by an isolating device of adequate rating as listed later.
 - 2.13 A voltmeter and ammeter shall be provided to indicate incoming voltage and along with rotary phase selection switches.
 - 2.14 LED type indicating lamps in approved colours shall be provided for the 3 phases and for status of all controlled devices.
 - 2.15 All the switchgear shall be earthed to the earth bus.
 - 2.16 Earth shall be extended for each compartment to the door by means of a flexible, insulated copper conductor with crimped legs on either side.
 - 2.16.1 Each panel shall be provided with suitable size of earth bus at the rear of the panel and two earth terminals on either side.
 - 2.16.2 Suitable printed PVC ferrules shall be provided for all the conductors for easy identification.
 - 2.17 Etched plastic name plates shall be provided for all the incoming, outgoing switchgears, ammeter, voltmeter etc.
 - 2.18 All the control and auxiliary wiring shall be carried out with PVC insulated copper conductor of proper colour code
 - 2.19 The power wiring from the circuit/air breakers to the starters shall be carried out using colour coded, PVC insulated copper conductors crimped with lugs.
 - 2.20 The outgoing wires of starters shall also be pvc insulated colour coded copper conductor crimped with lugs and terminated on a terminal block of proper rating.

Important Note

All Panel fabrication drawings shall be got approved, before the start of the fabrication work.

3. Bus Bars:

- 3.1 The Bus Bar shall be mounted in a separate compartment in the Panel Board.
- 3.2 The Bus Bars and interconnections shall be of aluminium strips unless otherwise specified.

3.3 The Bus Bar shall have rectangular cross - section of $(1) \text{ mm}^2$ per Amp. rating for full load current in the 3 phases as well as for neutral and should be extendable, if mounted horizontally.

3.4 The Bus Bars shall be insulated with heat shrink sleeves and colour coated. They should be supported on supports made of glass fibre reinforced thermosetting compound at regular intervals sufficient to withstand the force of any short circuit.

4. **Circuit Breakers:**

The panel and the bus bars plus outgoing of all devices shall be protected by different types of circuit breakers as described below and conforming to specification as given later on:

S.No.	Type	Upto 40 Amp.	63 A	80 to 200 A	Above 200 to 400 A	Above 630 A
1.	Incoming	MPCB	MCCB	MCCB	MCCB	ACB
2.	Outgoing	MPCB	MPCB	MCCB	MCCB	ACB

4.1 **Air Circuit Breaker (ACB)**

4.1.1 The air Circuit Breakers shall be Draw out type conforming to I.S: 13947 (Part 2) 1993.

4.1.2 The ACB shall be complete with solid state overload, short circuit and earth fault protection with adjustable settings.

4.1.3 Each ACB shall have 4 'NO' and 4 'NC' potential free auxiliary contacts, in addition to those required for its internal operating mechanisms.

4.1.4 There shall be suitable indicators for OPEN/CLOSE/SERVICE/TEST and Spring charged positions.

4.1.5 It shall be possible to close the door in Test position.

4.1.6 Castle Key and/or other interlocking devices shall be provided as required.

4.2 **Moulded Case Circuit Breakers (MCCB)**

4.2.1 The MCCB shall have TP + NL and be suitable for simultaneous manual opening and closing with rotary operating handle.

4.2.2 The ON/OFF/TRIP positions shall be clearly marked and easily visible to an operator and confirm to latest IS: 13947-1993.

4.2.3 There shall be fixed/adjustable tripping devices with inverse time characteristics for

overload and short circuit protection.

4.2.4 Suitable Interlocking mechanism shall be provided, where required.

4.3 **Motor Protection Circuit Breakers (MPCB)**

4.3.1 The MPCB shall have quick make/break contacts with a heat-resistant housing, having high Impact strength and confirm to IS 8828-1996.

4.3.2 The contacts shall be of silver nickel alloy.

4.3.3 The MPCB shall permit overload for short duration, as required for Inductive loads and the breaking capacity shall not be less than 10 KV at 415 Volt A.C.

4.3.4 It shall be equipped with overload and short circuit protection devices and shall be suitable for DIN mounting.

4.4 **Isolator Switches**

4.4.1 Isolator switches are to be provided for equipment located outdoors or for those located in separate enclosure, other than those Nos. having the Electric Panel.

4.4.2 The Isolator Switch should be of Rotary Load Break type with a weatherproof sheet steel enclosure. Its rating shall be same as the outgoing device in the Electric Panel.

5. **Contactors:**

All non-inductive loads shall be provided with suitable sized magnetic contactors.

5.1 The contactors shall have 3/4 poles plus a minimum 2 'NO' and 2 'NC' contacts. All contacts shall be of solid silver.

5.2 The No volt coil shall generally be suitable for 220 Volts + 10%, - 15% (wide band type) A.C. supply except when specified or required otherwise.

6. **Starters:**

6.1 The type of starters to be provided for the motors shall be as follows:

6.1.1 Squirrel Cage motors : upto 7.5 HP (5.6 KW) Direct On-Line Type

6.1.2 Squirrel Cage motors : Above 7.5 HP (5.6 KW) Automatic Star Delta Type

6.1.3 Compressor motor : Above 300 HP (225 KW) Automatic Auto Transformers
(where specified)

6.1.4 All starters shall have auxiliary contacts for interlocking different machines, connecting indicating lights, controls, alarms, etc.

6.1.5 All starters shall be provided with separate single phasing preventors.

7. Panel Accessories:

- 7.1 All Voltmeters and Ammeters as specified shall be square of 96 mm x 96 mm, flush mounting type.
- 7.2 The Indicating Lamps shall be of LED type with Low Watt Power. The Lamps shall have translucent covers of following colours.
 - 7.2.1 Red/Yellow/Blue for phase light.
 - 7.2.2 Green/Amber for ON/OFF indication.
 - 7.2.3 Concealed door lock.

8. Subsidiary Panels (With Single Switch):

- 8.1 Subsidiary panels shall be provided for equipment located away from the plant room, such as air handling units, blower etc.
- 8.2 The construction of these panel should be similar to the main panel and shall have all related accessories, except when specified.
- 8.3 The sub panel shall be wall hung type and as compact as possible.
- 8.4 Panel fabrication drawings shall be got approved before fabrication.

9. Squirrel Cage Motors:

- 9.1 The squirrel cage motors shall be either screen protected, or totally enclosed fan cooled, depending on the application and as stated in “schedule of equipment”. All motors shall conform to IS 325/1978, IS: 1231 for foot mounted motors and IS:2223 for flange mounted motors.
- 9.2 The stator windings shall be with class ‘B’ insulation.
- 9.3 Motors shall be provided with ball/ roller bearings. Bearings shall have ample capacity to deal with any axial thrust. Suitable grease nipple shall be provided for regreasing the bearings.
- 9.4 Motors shall be provided with a cable box for terminating the PVC insulated, PVC sheathed armored aluminum cables.

10. Installation of Motor:

- 10.1 Installation of the motor shall be in accordance with IS-900.
- 10.2 The motor along with its driven machine or equipment shall be provided with vibration isolation arrangement motors shall generally be provided with slide rails fixed to the base units nuts and bolts to facilitate belt installation and subsequent belt tension.

10.3 Motors shall be wired as per the detailed specifications and drawings all the motor frames shall be earthed with 2 Nos. of earthing conductors.

10.4 Motors shall be tested at works in accordance with the relevant Indian standard specifications and test certificates shall be furnished in triplicate.

Note : Rubber mats of 1100 volts capacity shall be laid in front of panel as per site requirement and no extra shall be paid.

11. **Painting:**

All sheet steel work shall undergo a multi tank process of degreasing, pickling in acid, cold rinsing, phosphating, passivating and then sprayed with a high corrosion resistant primer. The primer shall be baked in oven. The finishing treatment shall be by application of powder coated paint of approved shade and stoved.

IV **DUCT WORK AND OUTLET (FACTORY FABRICATED)**

1. **Scope:**

The scope of this section comprises supply fabrication, installation and testing if all sheet metal / aluminum ducts.

2. **Governing Standards:**

Unless otherwise specifications here, the construction, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standard – Metal and Flexible – Second Edition 1995" – SMACNA)

3. **Raw Material:**

3.1 **Ducting:**

3.1.1 All ducting shall be fabricated of LFQ (Lock Forming Quality) grade prime G.I. raw material furnished with accompanying Mill Test Certification.

3.1.2 Galvanizing shall be of 120 gms/sqm (total coating on both sides)

3.1.3 In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating at contractor's expense

3.1.4 The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions.

3.2 **Duct Connectors and Accessories:**

3.2.1 All transverse duct connectors (flanges/cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized)

4. **Fabrication Standards:**

All ductwork including straight sections, tapers, elbows, branches, showpieces, colors, terminal boxes and other transformation pieces must factory-fabricated or by equivalent technology. Equivalency will require fabrication by utilizing the following machines and processes to processes to provide the requisite quality of ducts and speed of supply.

- 4.1 Coil lines to ensure location of longitudinal seams at comers / folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along with any face side of the duct.
- 4.2 All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions.
- 4.3 All edges to be machine treated using lock formers, flangers and roller for turning up edges.
- 4.4 Sealant dispensing equipment for applying built in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.

5. **Selection of G.I. Gauge and Transverse Connector:**

- 5.1 Duct construction shall be in compliance with 1" (250 pa) w.g. static norms as per SMACNA.
- 5.2 All transverse connectors shall be the 4-bolt slip-on flange system or 4 bolt system with TDC flange or equivalent imported makes of similar 4-bolt system with built in sealant.
- 5.3 The specific class of transverse connectors and duct gauges for a given duct dimension will be as per table 1 below for the 1" (250 pa) pressure class.
- 5.4 Non-toxic, AC –applications grade P.E. or P.V.C Gasketing is required between all running flange joints. Gasket sizes should confirm to flange manufacturer's specifications.

Table 1:

For selection of flange class and duct gauges at 1200 mm spacing						
Duct Dimension	Duct pressure in inches					
	1"(250)*5	2"(500)	3"(750)	4"(1000)	6"(1500)*4	10"(2500)
In mm	Reinforcement Class – Duct Gauge					
Upto 250	*3E-26	E-26	E-26	E-26	E-26	E-24
251 – 300	E-26	E-26	E-26	E-26	E-24	E-24
301 – 350	E-26	E-26	E-26	E-26	E-24	E-22

351 – 400	E-26	E-26	E-26	E-26	E-24	E-22
401 – 450	E-26	E-26	E-26	E-26	E-24	H-20
451 – 500	E-26	E-26	E-24	E-24	E-24	H-20
501 – 550	E-26	E-26	E-24	E-24	H-24	H-20
551 – 600	E-26	E-26	E-24	E-24	H-22	H-20
601 – 650	E-26	E-26	E-24	E-24	H-22	H-20
651 – 700* ²	E-26	E-26	E-24	H-24	H-22	H-18
701 – 750	E-26	E-26	E-24	H-24	H-22	J-18
751- 900	E-26	E-24	E-24	H-22	H-20	J-18
901 – 1000	E-26	H-24	H-22	H-20	J-18	J-16
1001 – 1200	E-24	H-22	H-20	J-18	J-18	
1201 – 1300	* ³ H-24	H-20	J-18	J-18	J-16	
1301 – 1500	H-24	H-18	J-18	J-16		
1501 – 1800	H-22	J-18	J-16			
1801 – 2100	* ³ J-20	* ³ J-20				
2101 – 2400	J-18	J-18				
2401 – 2700	J-18					

Notes:

- *1- SMACNA- Sheet Metal and Air Conditioning Contractor's Association Inc-“HVAC Duct Construction Standards- Metal and Flexible” – 1995 U.S.A
- *2- **Reading Guide-** for duct size between, say 651mm and 700mm, when the pressure class is 1” w.g. static we require a “E” class flange and duct gauge of 26. For the same size range but with static pressure at 4” w.g. a ‘h’ Class flange with duct gauge of 24 should be used
- *3- The flange classes available are designated e, hand j. For E and H class of flange use gasket size 10 mm wide and 45 mm thick. For J Class use 15 mm wide and 6 mm thick gasket.
- *4- For pressure Class 6” w.g. static and above contact manufacture to confirm the gasket type & size.
- *5- (Not Applicable for current Specifications) For non-critical comfort cooling applications (1” w.g. pressure class) optional “C & S” or “C & SS” cleat joints can be used.

Upto 450 mm duct size use ”C & S” Cleats
 415 to 750 m duct size use “C & SS” Cleats

Over 750 mm duct size use flanges as specified or as per manufacturer's standard.
 All higher class flang can always be substituted for a lower class (e.g. class “J” for class “H”.
 class “H” for Class “E”)

- *6- The TDC flange classes remain same in all sizes, use gasket size 12 mm wide and 4 mm thick in all sizes.

6. **Duct Construction:**

- 6.1 The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps.
- 6.2 Dimensional Tolerance: All fabricated dimensions will be within ± 1.0 mm of specified dimensions. To obtain required perpendicularity. Permissible diagonal tolerance shall be ± 1.0 mm per meter.
- 6.3 Each and every duct piece should be identified by colour coded sticker which shows specific part numbers, job name, drawing number, duct size and gauge.
- 6.4 Duct shall be straight and smooth and the inside. Longitudinal seams shall be airtight and at corners only which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.
- 6.5 Change in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitter shall be installed in all bends and duct colors designed to permit the air to make the turn without appreciable turbulence.
- 6.6 Plenums shall be shop/factory fabricated panel type and assembled at sight.
- 6.7 The deflection of transverse joints should be within specified limit for rectangular duct deflection as given in SMACNA. Page No, 7.6
- 6.8 Reinforcement of duct shall be achieved by either cross breaking a straight beading depending on length of ducts.

As per SMACNA Page No.1.74, fig 1-8

“Duct Size 19” (483 mm) wide and larger which have more than 10sqft of unbraced panel shall be beaded or cross broken unless duct will have insulation covering or acoustical liner. This requirement is applicable to 20 g(1.00 mm) or less and 3” w.g(750 pa) pressure or less. Duct for 4” w.g. (1000 pa) or more do not require beads or cross-breaks”.

7. **Support System:**

- 7.1 A completely galvanized system consisting of fully threaded rods, slotted angles or double L bottom brackets (made out of 3.0 mm M.S. sheet) nuts, washer and anchor bolts conforming to SMACNA standards should be used.

Sr. No.	Maximum Duct Size(mm)	Hanger Rod Diameter	Interval (mm)
1.	Up to 700	6mm	2400
2.	701 – 1200	8 mm	2400
3.	1201 – 2000	10 mm	2400

4.	Above 2000	12 mm	2400
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7.2 As an alternative, slotted galvanized brackets attached to the top two bolts of the system may also be used as appropriate for the site condition.

7.3 To provide the required thermal brake effect, Neoprene or equivalent material of suitable thickness shall be used between duct support and duct profiles in all supply air duct does not enclose by return air plenums.

8. **Installation:**

8.1 **Tools and tackles for site work**

The duct installation shall confirm to SMACNA norms. For duct assembly and installation, the use of suitable tools and tackles should be used to give the required duct quality and speed of installation including (but not restricted to)

- a) Electric Pittsburgh seamer - used for closing Pittsburgh joints
- b) Electric Slitting Shear - to make cut – outs
- c) Drilling machine and drill - for drilling holes sheet metal work
bitts
- d) Hammer drill machine - for drilling holes in building structure for
with drill bits anchor
- e) Hoisting system - for lifting the duct assembly up to
mounting heights

8.2 **Installation Practice**

All ducts shall be installed as per tender drawings and in strict accordance with approved shop drawing to be prepared by the Contractor

8.2.1 The contractor shall provide any neatly erect sheet metal work as may be required to carry out the intent of these specifications and drawings. The work shall meet with the approval of owner's site representative in all its parts and details.

8.2.2 All necessary allowances and provisions shall be made by the contractor for beams, pipes or other obstructions in the building whether or not the same are shown on the drawings. Where there id interference /fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably modified as per actual site conditions.

8.2.3 Ducting over false ceiling shall be supported from the slab above, or from beam, in no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. Al metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

8.2.4 Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick appropriate insulation around the duct and totally covered with fire barrier mortar for complete sealing.

8.2.5 All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units or blowers coil unit that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge.

9. **Documentation & Measurement for Ducting:**

9.1 For each drawing, all supply of duct work must be accomplished by computer generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct area by gauge and duct size range as applicable.

9.2 Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.

9.3 All duct pieces to have a part number, which should correspond to the serial number assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

10. **Testing:**

After duct installation, a part of duct section (approximately 5% of total ductwork) may be selected at random and tested for leakage. The procedure for leak testing should be followed as per SMACNA –“ HVAC Air Duct Leakage Test Manual” (First Edition)

12. **Heating / Cooling Thermally Powered Diffuser / Grille:**

12.1 Each diffuser shall be thermally powered to infinitely vary the supply of air into space, in either heating or cooling mode, by means of regulating a variable aperture damper, known as a control disc, vertically within the diffuser. Supply air from the variable geometry diffusers will discharge horizontally in a 360^o pattern and will maintain constant air movement in the space throughout the range of volume variation from 100% down to 25%.

12.2 The thermal room sensing element shall be location behind an induction cap in the center of the diffuser panel and shall provide no more than 1^o F thermal deadband between induced temperature and zone temperature.

12.3 Each diffuser shall be individually adjustable to sense room temperature within the space between 68^o F and within 77^o F. Each diffuser shall be individually adjustable for minimum airflow from 0 to 30%. Each diffuser is to be fitted with a single thermally supply air sensing element to automatically change from and to a cooling and heating mode and be able to infinitely vary the supply of air into the space in either mode. Each diffuser shall be self – contained and require no external power source to maintain space temperature throughout the range of operation. The diffusers shall carry the manufacture’s 10-year warranty.

- 12.4 Ceiling diffuser shall be square, architectural, panel face diffusers. The diffuser shall have an 18-gauge steel face panel mounted on an aerodynamically shaped, one-piece, seamless back pan. The diffuser face panel must be field removable by means of four positive locking clips. The exposed surface of the face panel shall be smooth, flat and free of visible fasteners. The face panel cannot project more than 1/8 inch below the outside border of the diffuser back pan.
- 12.5 The face panel shall have an aerodynamically shaped, hemmed edge. A single Metal thickness on the edge of the face panel is not acceptable. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel. The entire diffuser shall be constructed of steel, with an integral drawn inlet. The diffuser neck shall have a minimum 1^{1/8}-inch depth available for duct connection.
- 12.6 Finish shall be thermoset alky-melamine enamel paint, baked at 315⁰ F .The paint hardness must be 2H to 3H. The paint passes a 300-hour ASTM D 1654 corrosive Environment Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass the 500-hour ASTM D870 water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact cracking Test with 50-inch pound applied.
- 12.7 Alternatives to the specified product must provide published performance ratings that meet or exceed the performance of the T₃ SQ ceiling diffuser. All test data shall be obtained in accordance with ANSI/ ASHRAE Standard 70-1991, and ARI Standard 880-98. A copy of the certified test results shall be provided upon request. The VAV diffuser shall be ARI certified.

13. **Fire & Smoke Dampers:**

Combination Fire Smoke Damper –

- 13.1 Combination Fire Smoke Dampers meeting the following specifications shall be furnished and installed where shown on plans and/or as described in schedules. Dampers shall meet the requirements of the latest edition of NFPA 90A, 92A, and 92B.
- 13.2 **Dampers shall be tested, rated and labeled in accordance with the latest edition of UL Standards 555 and 555S.** Dampers shall have a UL555 fire rating of 1 1/2 hours. Each damper shall be equipped with a heat responsive device which has been tested and approved for use with the damper assembly in accordance with UL555. The heat responsive device shall have a temperature rating of (specifier select one of the following) 74 C or 100 C. Dampers shall be UL labeled for use in dynamic systems. The damper shall have a dynamic closure airflow rating equal to or greater than the airflow at the damper's installed location and a dynamic closure pressure rating of 101.6 mm H₂O.
- 13.3 Dampers shall have a UL555S Leakage rating of Class I and a Temperature rating of 177 C. Dampers shall have a UL555S operational airflow rating equal to or greater than the airflow at its installed location and an operational pressure rating of 101.6 mm H₂O. Damper actuators shall be factory mounted and qualified for use with the damper in accordance with UL555S. Damper actuators shall be electric type for 220 /24-volt operation. Actuator shall be of Honeywell or Belimo make.

- 13.4 All UL555 and 555S Dynamic Closure Ratings, Operational Ratings and Leakage Ratings shall be qualified for airflow and pressure in either direction through the damper. UL ratings shall allow for mounting damper vertically (with blades running horizontal) or horizontally.
- 13.5 The Damper Manufacturer's submittal data shall certify all air performance pressure drop data is licensed in accordance with the AMCA Certified Ratings Program. Damper air performance data shall be developed in accordance with the latest edition of AMCA Standard 500-D.
- 13.6 Damper blades shall be 1.6 mm galvanized steel 3 Vee type with three longitudinal grooves for reinforcement. Blades shall be completely symmetrical relative to their axle pivot point, presenting identical resistance to airflow and operation in either direction through the damper (blades that are non-symmetrical relative to their axle pivot point or utilize blade stops larger than 13 mm are unacceptable).
- 13.7 Damper frames shall be galvanized steel formed into a structural hat channel shape with reinforced corners. Bearings shall be sintered bronze sleeve type rotating in extruded holes in the damper frame. Jamb seals shall be stainless steel compression type.

14. **Actuators:**

The actuator used shall be maintenance free direct coupled spring return suitable to work on 24 V electric supply. The torque rating of the actuator shall exceed at least by 15% over torque required to open/close the damper. The selection of actuator size shall be the responsibility of the manufacture of the fire damper. Spring return time shall be 20 seconds or less at ambient temperature other features of the damper actuator shall be as under.

- a) It has tamper proof housing with IP-54 protection rating.
- b) Shall have mechanical integrity of at least one hour at 900⁰ C.
- c) Shall have minimum 60000 safe position at rated torque. It shall be capable to withstand temperature of 75⁰ C for 24 Hrs.
- d) Shall have electronic overload or digital sensing circuit to prevent damage to actuator.
- e) Should be capable of changing direction of rotation by changing mounting orientation.
- f) Shall have manual override facility.

15. **Control Panel:**

The control panel shall be supplied by damper manufacturer fitted on damper compatible with damper actuators. The control panel shall have at least followed features.

- i. Power on indicating lamps with 230 V/24 V transformer.
- ii. Damper close & open indication.
- iii. Reset push button.
- iv. Push button for manual running of actuator for periodic inspection.
- v. Auxiliary contacts 24 V & 230 V.
- vi. Contact points to receive signal from smoke defector/fire alarm panel.

The control panel shall receive 230 V A/C supply & interconnecting wiring between control panel & actuator shall be done using fireproof cables.

Access door will be provided in the duct before each fire damper.

16. **Access panel:**

- 16.1 A hinged and gasketed access panel measuring at least 450 mm x 450 mm shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct work.

17. **Miscellaneous:**

- 17.1 All duct work joints are to be true right angle and with all sharp edges removed.
- 17.2 Sponge rubber gaskets also to be provided behind the flange of all grilles.
- 17.3 Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.
- 17.4 Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.
- 17.5 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 owner/owner engineer consultant/architect.
- 17.6 The ducts should be routed directly with a minimum of directional change.
- 17.7 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the owner/owner engineer consultant/architect, at no extra cost.
- 17.8 All angle iron flanges to be welded electrically and holes to be drilled.
- 17.9 All the angle iron flanges to be connected to the GSS ducts by rivets at 100 mm centers.
- 17.10 All the flanged joints, to have a sponge rubber packing stuck to the flanges with suitable adhesive.
- 17.11 The G.S.S. Ducts should be lapped 6 mm across the flanges.
- 17.12 The ducts should be supported by approved type support at a distance not exceeding 2.4 metres.

18. **Standard Grilles:**

- 18.1 The supply and return air grilles shall be fabricated from extruded Aluminium sections. The supply air grilles shall have single/double louvers. The front horizontal louvers shall be of extruded section, fixed/adjustable type. The rear vertical louvers where required

shall of Aluminium extruded sections and adjustable type. The return air grille shall be have single horizontal extruded section fixed louvers. The grilles may or may not be with an outer frame.

- 18.2 The damper blades shall also be of extruded Aluminium sections. The grill flange shall be fabricated out of Aluminium extruded section. Grilles longer than 450 mm shall have intermediate supports for the horizontal louvers.

19. **Diffusers/Slot Diffusers:**

- 19.1 The ceiling type square diffusers shall be of Aluminium extruded sections with flush or step-down face, as specified with fixed pattern and neck.
- 19.2 All supply diffusers shall be provided with extruded Aluminium dampers, with arrangement for adjustment from the bottom.
- 19.3 The slot diffusers shall be of Aluminium extruded sections with diffusion plate and sliding damper.

20. **Linear Diffusers/Grilles:**

- 20.1 The linear diffusers/grilles shall be fabricated from Aluminium extruded sections.
- 20.2 The diffusion blades shall be extruded, flush mounted type with single or double direction air flow.
- 20.3 The frame shall be of Aluminium extruded section and shall hold the louvers tightly in fixed position.
- 20.4 The dampers as described under grilles shall be provided wherever specified.

21. **Painting:**

- 21.1 All grilles, and diffusers shall be powder coated, before installation, in approved colour.
- 21.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.

22. **Testing:**

- 22.1 After completion, all duct system shall be tested for air leakage.
- 22.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final tabulation of air quantity through each outlet shall be submitted to the owner/owner engineer consultant/architect for approval.
- 22.3 All sample required to approved by the Architect/client.

V DUCT WORK AND OUTLET (SITE FABRICATED)

1. General:

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

2. Duct Materials:

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

The thickness of the sheet shall be as follows: -

	Sheet thickness	Type of		Bracing if any Joint	
	Size of Duct	G.I.	Aluminium		
2.2.1	Upto 750 mm	0.63 mm	0.80 mm	G.I. Flange	--
2.2.2	751 mm to 1000 mm	0.80 mm	1.00 mm	25x25x3 mm angle iron frame with 8 mm dia nuts & bolts	25x25x3 mm angle iron frame at the rate of 1 mt.
2.2.3	1001 mm to 1500 mm	0.80 mm	1.00 mm	40x40x5 mm angle iron frame with 8 mm dia nuts & bolts	40x40x3 mm angle iron frame at the rate of 1 mt.
2.2.4	1501 mm to 2250 mm	1.00 mm	1.50 mm	50x50x5 mm at angle iron with 10 mm dia nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.2 mt. to be crossed braced diagonally
2.2.5	2251 mm and Above	1.25 mm	1.80 mm	50x50x6 mm at angle iron the rate of frame with 1.6 mt. 10 mm nuts & bolts at 125 mm centre	40x40x3 mm at the rate of 1.2 mt. to be crossed braced diagonally

- 2.3 The gauges, joints and bracings for sheet metal duct work shall further conform with the provisions as shown on the drawings.
- 2.4 Ducts larger than 450 mm shall be cross broken, duct sections upto 1200 mm length may be used with bracing angles omitted.
- 2.5 Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 Deg. Angle from the axis of the main duct unless otherwise approved by the engineer-in-charge.
- 2.6 All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 9 mm (3/8") Dia with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

3. **Installations:**

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

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

- 3.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.
- 3.5 The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subject to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the engineer-in-charge of any difficulty in carrying out his work before fabrication.
- 3.6 Sponge rubber or approved equal gaskets shall be installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metals connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.
- 3.7 Flanges bracings and supports are to be black, mild steel and are to be galvanized on all surfaces before erection. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as

specified.

- 3.8 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct.
- 3.9 Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or galvanized as appropriate.
- 3.10 Flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
- 3.11 The flexible joints are to be not less than 75 mm and not more than 250 mm between faces.
- 3.12 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

4. **Dampers:**

- 4.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than the gauge of the large duct and shall be rigid in construction.
- 4.2 The volume dampers shall be of an approved type, lever operated and complete with locking devices which will permit the dampers to be adjusted and locked in any positions.
- 4.3 The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 mm (18) gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm. Angles shall not interfere with the operation of dampers, nor cause any turbulence.
- 4.4 Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.6 mm steel sheets and blades shall not be over 225 mm wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with fine mesh.
- 4.5 Wherever required for system balancing, a volume balancing opposed blade damper with quadrant and thumb screw lock shall be provided.
- 4.6 After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.
- 4.7 Automatic fire dampers shall be provided wherever shown on the drawings. The damper shall be multiblade curtain type. The blades should out of the air stream in open position and shall be constructed with minimum 1.8 mm thick aluminium sheets. The frame shall

be of 1.6 mm thickness. Other materials shall include return spring, locking device, solenoid actuator, etc.

The fire dampers shall be capable of operating automatically with the actuation of smoke/heat detector. Units fans shall be interlocked with the damper.

5. **Access panel:**

5.1 A hinged and gasketed access panel measuring at least 450 mm x 450 mm shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct work.

6. **Miscellaneous:**

6.1 All duct work joints are to be true right angle and with all sharp edges removed.

6.2 Sponge rubber gaskets also to be provided behind the flange of all grilles.

6.3 Each shute from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

6.4 Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

6.5 Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-In-Charge.

6.6 The ducts should be routed directly with a minimum of directional change.

6.7 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the Engineer-In-Charge, at no extra cost.

6.8 All angle iron flanges to be welded electrically and holes to be drilled.

6.9 All the angle iron flanges to be connected to the gss ducts by rivets at 100 mm centers.

6.10 All the flanged joints, to have a sponge rubber packing stuck to the flanges with suitable adhesive.

6.11 The G.S.S. Ducts should be lapped 6 mm across the flanges.

6.12 The ducts should be supported by approved type supports at a distance not exceeding 2.4 metres.

7. **Standard Grilles:**

7.1 The supply and return air grilles shall be fabricated from extruded aluminium sections. The supply air grilles shall have single/double louvers. The front horizontal louvers shall be of extruded section, fixed/adjustable type. The rear vertical louvers where required shall

of aluminium extruded sections and adjustable type. The return air grille shall have single horizontal extruded section fixed louvers. The grilles may or may not be with an outer frame.

- 7.2 The damper blades shall also be of extruded aluminium sections. The grill flange shall be fabricated out of aluminium extruded section. Grilles longer than 450mm shall have intermediate supports for the horizontal louvers.

8. **Diffusers/Slot Diffusers:**

- 8.1 The ceiling type square diffusers shall be of aluminium extruded sections with flush or step-down face, as specified with fixed pattern and neck.

8.1.1 Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7mm and fitted with a suitable flexible gasket between the concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick aluminum sheet. The louvers shall be of aero foil design of extruded aluminum section with minimum thickness of 0.8mm at front and shall be made of 0.8mm thick aluminum sheet. Louvers may be spaced 18 mm apart.

8.1.2 Square and rectangular ceiling outlets/intakes shall have a flange flush with the ceiling into which it is fitted or shall be of anti-smudge type. The outlets shall comprise an 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 1.6 mm thick extruded section aluminum sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminum section

- 8.2 All supply diffusers shall be provided with extruded aluminium dampers, with arrangement for adjustment from the bottom.

8.3 The slot diffusers shall be of Aluminium extruded sections with diffusion plate and sliding damper.

8.4 Circular ceiling outlets/intakes 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 aluminum sheet.

9. **Linear Diffusers/ Grilles:**

- 9.1 The linear diffusers/grilles shall be fabricated from Aluminium extruded sections.

9.2 The diffusion blades shall be extruded, flush mounted type with single or double direction air flow.

9.3 The frame shall be of aluminium extruded section and shall hold the louvers tightly in fixed position.

9.4 The dampers as described under grilles shall be provided wherever specified.

9.5 Linear diffusers 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.

10. **Fresh Air Intakes:**

- Fresh air intake grills shall be made of extruded aluminum sections.
- A flanged frame using RS sections shall be provided on front face to conceal the gap between the louvers and the adjoining wall face. Corners of frame shall be welded. The frame shall be made structurally rigid.
- Louvers made from extruded aluminum section shall be in modular panel form for ease of handling. These shall be free from waves and buckles. Vertical blades shall be truly vertical and horizontal blades shall be truly horizontal. Butt joints in blades shall not be accepted.
- Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/vibrating of the louvers, at not more than 750mm centers where the louver's length is longer than 750mm.
- 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.

11. **Fire dampers:**

- Fire dampers shall be provided in all the supply air ducts and return air ducts (where provided), return air passage in the air-handling unit room and at all floor crossings. Access door will be provided in the duct before each set of fire dampers.
- Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in Open position & shall allow maximum free area to reduce pressure drop & noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanized sheet & shall be factory fitted in a sleeve made out of 1.6mm galvanized sheet of minimum 400mm long. It shall be complete with locking device, motorized actuator & control panel.
- Fire dampers shall be motorized smoke & fire dampers type. It shall be supplied with spring loaded fusible link to close fire damper in the event of rise in duct temperature. Fire damper shall also close on receipt of fire alarm signal to cut off air supply instantaneously. An electric limit switch shall also be operated by the closing of fire damper, which in turn shall switch off power supply to AHU blower motor as well as strip heaters.
- Fire dampers shall be CBRI tested & certified for 90 minutes rating against collapse & flame penetration as per UL 555-1995 (Underwriters Laboratories)
- Fire dampers shall be compatible with the fire detection system of building & shall be capable of operating automatically through an electric motor on receiving signal from fire alarm panel.

12. Measurement:

- Duct measurements (for insulated ducts) shall be taken before application of insulation.
- Duct work shall be measured section wise on the basis of external surface area by multiplying the axial length from flange face to flange face for each section by the corresponding duct perimeter in the centre of that section length.
- Uniformly tapering straight sections shall also be measured as in (ii) above. However, for special pieces like tees, bends etc. area computations for surface areas shall be done as per the shape of such pieces.
- The quoted unit rate for external surfaces of ducts shall include all wastage allowances, flanges, gaskets for joints, vibration isolators, bracings, hangers and supports, inspection chambers/access panels, splitter dampers with quadrants and levers for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured.
- Grilles and diffusers (except linear diffusers) shall be measured by the cross-sectional areas, perpendicular to the airflow, and excluding the flanges. Volume control dampers, where provided shall not be separately accounted for.
- Linear diffusers shall be measured by linear measurements only, and not by cross sectional areas, and shall exclude flanges for mounting of the linear diffusers. The supply air plenum for linear diffusers shall be measured as described above for ducting.
- Fire dampers shall be measured by their cross-sectional area perpendicular to the direction of the airflow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, fusible link/ solenoid with wiring, but clouding the fire detectors, etc.

13. Painting:

13.1 All grilles and diffusers shall be powder coated, before installation, in approved colour.

13.2 All ducts immediately behind the grilles/ diffusers etc. are to be given two coats of black paint in matt finish.

14. Testing:

After duct installation, total duct work (Air-conditioning and Mechanical Ventilation Ducts) should be tested for leakage. The procedure for leak testing should be followed as per SMACNA – “HVAC Air Duct Leakage Test Manual” (First Edition – 1985)

14.1 Ductwork Leakage Tests

- 1) This section of the specification describes the ductwork leakage testing procedure.
- 2) All ductworks shall be pressure tested for leakage; smoke test is not acceptable. The subcontractor shall provide the necessary test equipment and skilled labour to carry out the tests satisfactorily.

- 3) Testes shall be witnessed and certified by the Client / PMC's representative. Prior to witness of final tests, the sub-contractor shall carry out preliminary tests to ensure the test results are within specified limits.
- 4) All duct work shall be tested for leakage without duct insulation or duct enclosure at the joints.
- 5) Accuracy of the test apparatus shall be within:
- 6) $\pm 5\%$ of the indicated flow rate or 0.5 l/s, whichever is greater, and
- 7) 5% of the indicated static pressure in duct under test.
- 8) The test apparatus shall have a calibration certificate; chart of graph dated not earlier than one year before the test for which it is used.

14.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final tabulation of air quantity through each outlet shall be submitted to the engineer-in-charge for approval.

VI INSULATION

1. Scope:

This chapter covers the requirements of thermal insulation for chilled water / hot water piping, pumps and tanks, duct work, and acoustic lining in duct work and weather maker rooms. This does not cover exposed roof insulation and under deck insulation work.

2. Material-Types:

The insulation material to be used for various applications shall be any of the following, as required:

- i) For insulation of water piping, pumps and tanks: -
 - a) Expanded polystyrene (T.F. Quality)
 - b) Resin bonded glass wool
 - c) Polyvinyl Nitrile (Closed cell rubber foam)
 - d) XLPE (Closed cell cross linked polyolefin foam)

Expanded polystyrene (T.F. Quality) shall be used for pipe insulation like inside the A.C. plant room, exposed to outside or buried in ground. In the case of expanded polystyrene (TF quality), Resin bonded glass wool the pipe insulation should be in rigid sections in two halves and preformed to fit snugly on to pipes (upto pipe sizes for which the preformed sections are manufactured by the manufacturer of insulation). For higher pipe sizes insulation slabs shall be used.

Resin bonded glass wool is to be used for piping inside the building due to its fire-retardant properties, for considerations of fire safety. Polyvinyl Nitrile (Closed cell rubber foam) available in tube shapes for sliding on to the small dia. pipes can be used if successfully tested for fire retardant properties.

However, all need to be covered with vapour barrier and cladding with aluminium sheet.

- ii) For Insulation of duct work: -
 - a) Resin bonded glass wool.
 - (b) Polyvinyl Nitrile (Closed cell rubber foam)
- iii) For acoustic lining of duct work and AHU rooms: -
 - (a) Resin bonded glass wool.
 - (b) Resin bonded mineral wool.
- iv) For suction line, Chilled water pipe and Chiller insulation: -
 - (a) Expanded Polysterene (T.F. Quality)
 - (b) Polyvinyl Nitrile (Closed cell rubber foam)
 - (c) Resin bonded glass wool.
- (v) For double skin AHUs:
 - (a) Polyurethane foam (PUF insulation)

3. **Insulation Thickness:**

The thickness of insulation shall be as indicated below unless specified otherwise in the tender specifications.

- i) For pipe insulation (for chilled water as well as hot water application

Pipe Size (mm)	Glass fibre /Exp. Polystyrene (mm)
150 & below	50
Above 150	75

- ii) For Duct insulation

Application	Fibre glass (mm)
Thermal for AC area	12.5
Thermal for Non AC area	25
Acoustic	25

- iii) For room acoustic lining

Resin bonded glass wool	50 mm
Resin bonded mineral wool	50 mm

- iv) For pumps :

Expanded polystyrene TF quality	50 mm
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- v) Chiller Insulation

Thickness of polyvinyl rubber insulation used for chiller insulation shall not be less than 19mm.

- vi) Expansion tank

Thickness of expanded polystyrene (TF quality) insulation used shall not be less than 50mm.

4. Application of Insulation on Pipes (including suction line insulation):

- (i) The surface to be insulated shall be first cleaned and a coat of zinc chromate primer shall be given. The insulation shall be fixed tightly to the surface with cold setting adhesive CPRX compound. All joints shall be staggered and sealed. The second layer of insulation wherever required shall be similarly applied over the first layer.
- (ii) Pipes shall be preferably pre-insulated at factory, meeting the requirement or the insulation shall be finished at site as under:
 - (a) For pipes laid inside the building, the insulation over the pipe work shall be finished with 0.63 mm thick aluminium sheet cladding over a vapour barrier of 120 gm/ sq.m. polythene sheet with 50 mm overlap and tied down with lacing wire and complete with type 3, grade-I roofing felt strip (as per IS 1322 as amended upto date) at the joints.
 - (b) For pipes outside the building laid above ground the finishing over the pipe insulation shall be finished with 0.63 mm G S sheet cladding over a vapour barrier of 120 gm/sq.m polythene sheet with 50mm overlap and tied down with lacing wire and complete with type 3 grade I roofing felt strip applied by means of cold setting CPRX compound.
 - (c) For pipes outside the building laid underground the insulation shall be covered with 500-gauge polythene faced hessian, (the polythene facing outwards), with 50 mm overlap. All joints shall be sealed with bitumen. A layer of 0.50 mm x 20 mm G.I. wire mesh netting shall be provided over it butting all joints and it shall be laced down with GI wire, sand cement plaster (1:4) 20 mm. thick shall be provided in 2 layers of each 10mm and shall be waterproofed by applying hot bitumen & fixing tar felt over the plaster. It shall be finally finished with a coat of hot bitumen.) In case of factory pre-insulated pipes, buried underground, a water leakage sensing wire shall also be provided, to detect the location of water leakage at later date.
 - (d) In case of factory pre-insulated pipes, all joints shall be properly insulated at site as per recommendation of manufacturer
- (iii) All valves, fittings, strainers etc. shall be insulated to the same thickness and in the same manner as for the respective piping, taking care to allow operation of valves without damaging the insulation.

5. Application of Insulation on Pumps:

Expanded polystyrene (TF quality) 50mm thickness shall be sandwiched between two aluminium sheets of 0.5mm thickness and properly clamped to pump in two semicircular sections.

6. Application of Insulation on Expansion Tank:

Insulation of expansion tank shall be expanded polystyrene (T.F. Quality) of thickness not less than 50mm. It shall be applied as under

- i) Surface shall be thoroughly cleaned with wire brush and rendered free from all dust & grease.
- ii) The two layers of hot bitumen shall be applied.
- iii) The insulation slabs will then be fixed in one layer and joints shall be sealed with hot bitumen.
- iv) The insulation slab then shall be covered with 0.63 mm x 19mm G.I. wire mesh netting which shall be fixed to insulation with brass / G.I. nails.
- v) The insulation shall then finally be finished with aluminium cladding of thickness not less than 0.5mm.

7. **Measurement of Insulation:**

- a) Pipe insulation shall be measured in units of length along the centre line of the insulated pipe. The linear measurements shall be taken before the application of the insulation. For piping measurements, all valves, orifice plates and strainers shall be considered strictly by linear measurement along the centre line of the pipes, and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.
- b) Duct insulation and acoustic lining shall be measured on the basis of surface area along the outer surface (ref IS14164 of 2008) of insulation thickness. Thus, the surface area of externally thermal insulated or acoustically lined duct shall be based on the perimeter at the centre of thickness of insulation, multiplied by the centre-line length of ducting including tapered pieces, bends, tees, branches etc. as measured for bare ducting. In the case of tapering pieces, their average perimeter shall be considered.

8. **Duct Insulation and Drain Pipe:**

The insulation for drain piping, and duct shall be carried out from closed cell electrometric nitrile rubber having a 'K' value of 0.034 W/(M.K) at mean temperature of 10⁰ C. and a density of not less than 40 kgs/cubm. Water vapour permeability 4000 U and above. Fire rating class I/O as per British standard BS 476 part VII/- - 1997 building regulation. Approval of sample to be obtained in writing prior to execution.

8.1 **Other Insulation:**

The material for acoustic treatment of ducts, rooms, roofs etc. shall be resin bonded fibre glass, as described earlier, conforming to I.S. 818 of 1976. The density of fibre glass shall be 32 kg/cub.m and the material shall be in the form of rolls of uniform density. The 'k' value at 10⁰ C. shall not be less than 0.028 kcal/mhr/⁰ C. Wherever insulation is to be carried out inside the duct, fibre tissue is to be installed and contractor to ensure that no fibers of insulation material get mixed up with supply/return air.

9 **Drain Piping:**

9.1 Insulation of drain piping shall be carried out using 9 mm thick insulation tube of closed cell electrometric nitrile rubber having a 'K' value of 0.034 W/(M.K.) at mean temperature of 10⁰ C and a density of not less than 40 kg/cubm.

9.2 **Installation**

9.2.1 The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.

9.2.2 Cut insulation tube longitudinally and put on pipe and sealed the joints with adhesive and Aluminium tape (as approved by manufacturer).

10. **Ducting:**

10.1 The ducts shall be insulated with the insulation sheets as follows.

10.2 Duct insulation thickness shall be as follows:

Duct in conditioned space - 13 mm thick

Duct in unconditioned space - 13 mm thick

Duct with treated fresh air - 13 mm thick

11. **Acoustic Lining:**

11.1 13 mm thick open cell nitrile rubber insulation as specified in BOQ.

11.2 **Installation**

11.2.1 The duct surface shall first be cleaned from inside.

11.2.2 Then the insulation shall be fixed inside the duct.

11.2.3 The insulation shall be covered with RP tissue.

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

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

VII ELECTRIC WIRING

1. General:

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

2. Wiring for Motors, Heaters etc:

2.1 The wiring for above equipment shall be carried out in conduits or using PVC armoured cables.

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

2.2.1 The cables shall be laid as per IS-1255/1967, Indian Standard Code of Practice.

2.2.2 The cables shall be laid, as per drawings or along a short and convenient route between switchboard and the equipment, either in trenches, on wall or on hangers, supported from the slab. Cable routing shall be checked on the site to avoid interference with structure, equipment etc. Where more than one cables are running close to each other, proper spacing should be provided between them.

2.2.3 The radius of bends of the cable should not be less than 12 times the radius of cable to prevent undue stress and damage at the bends, the cables should be supported with wooden cleats fixed on M.S. Supports, when running in trenches, wall or ceiling suspended hangers. When laid underground the cables should be covered with fine soft earth and protected with cement concrete covering. Suitable G.I. Pipe shall be used wherever the cable comes out of the connected surface and clamped properly.

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

2.2.4 All cables shall be terminated using suitable size cable glands and packing.

2.3 The wiring in conduits shall be 1100 volts grade.

2.3.1 The conduits used shall be of high quality, all joints shall be made with sockets. The bends and elbows shall have inspection covers fixed with grease free screws. The joints shall be watertight. Approved metal saddles shall be used to secure the exposed conduits at a space of 1 meter or less. The connection of the conduit to switches etc., shall be secured by a check nut and ebonite bushes provided at the ends of conduits.

2.3.2 Flush inspection covers shall be provided in case of concealed, recessed conduits. The staples for the conduits shall not be spaced more than 0.60 meters apart. Before filling up the chase with concrete the conduits should be given a coat of rust proof paint.

2.3.3 The wires shall be drawn only after all the conduits have been properly fixed in position.

3. **Control Wiring:**

3.1 Control cables shall be 1100 volts grade as per IS 1554 made from copper conductor of 1.5/2.5 sq. mm PVC insulated single multi core unarmoured with an overall PVC sheathing.

3.2 The cables and conduits wiring shall be carried out as per details given under 2.2 and 2.3 above.

4. **Earthing:**

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

Size of phase wire sq.mm Aluminium	size of copper conductor tape/wire (swg)
300	25 mm x 6 mm (strip)
185	20 mm x 3 mm (strip)
150	20 mm x 3 mm (strip)
120	12 mm x 3 mm (strip)
95	4 Swg
70	4 Swg
50	6 Swg
35	8 Swg
25-6	8 Swg
4	10 Swg

Note :- GSS earthing conductors of equivalent size may be used in lieu of copper earth mentioned above.

5. **Miscellaneous:**

5.1 The final connections to the equipment shall be through flexible connections in case of conduit wiring and also where the equipment is likely to be moved back and forth, such as on slide rails.

5.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.

5.3 Two separate and distinct earthing conduits shall be connected from the equipment upto the main switchboard panel.

5.4 The branch lines from the main panel to each equipment shall be separated and should not criss cross other lines.

- 5.5 The entire installation shall be tested as per electricity rules and I.S.S 732-1973 with amendments 1,2 & 3 prior to the commissioning of the plant and a suitable test report furnished by a competent and authorized person. The test report will be obtained by contractor himself at his own expenses.
- 5.6 All exposed switch board panels, conduits, hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

VII I TESTS AT SITE/WORKS

1. General:

The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the Architect/ Consultants/ Owner representative, site engineer-in-charge in accordance with the provisions of the applicable ASHRAE standards or approved equal and furnish necessary test certificates from manufacturers at the time of delivery of requirement at site.

2. Initial Inspection at Site :

2.1 Ducting

- The sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness and bend test as per relevant IS specifications.
- Zinc coating of GSS sheet as mentioned in the tender documents may be got tested from a laboratory to verify that same meets the contract requirements.

2.2 Pumps

- Salient features such as model and make shall be checked as per contract requirements.
- The manufacturer's test certificates with Sr. No., head, discharge will be furnished and verified against contract requirements.

2.3 Switch Gear, Control Gear and Measuring Instruments

These should be of specified make. For air circuit breaker manufacturers test certificate shall be furnished by contractor and the same shall be verified as per contract requirements.

- 2.4 Electric motors should be of specified make, manufacturer's test certificate for electric motor shall be furnished.

2.5 Pipes

- It should be checked that the same is as per makes specified in contract

- Dimensions including weight shall be checked for pipes against the requirements contract.

2.6 **Insulation and Acoustic Lining**

- Physical verification for thickness and make should be made as per contract before application of insulation.
- Manufacturer's test certificate for density should be furnished. Note: Accuracy of testing instruments shall be as mentioned in the final inspection procedure.

3. **Final Inspection:**

- 3.1 After completion of the entire installation as per specification in all respects, the AC contractor shall demonstrate trouble free running of the AC equipments and installation for a period of minimum 120 hours of running as detailed under Para 1.15.
- 3.2 After the trial run as in Para 1.15 above, the AC contractor shall offer the plant for the seasonal test, namely test for summer or monsoon season whichever occurs earlier. The test results as per Appendix G shall be furnished.
- 3.3 The equipment capacity computations as per Para '8' under notes of the Annexure 'G' shall be carried out.
- 3.4 The Input KW of the unit/TR at full load shall also be checked against contract requirements, if any.
- 3.5 Pressure drops across chiller and condenser at specified flow rates shall be checked against the contract requirements.
- 3.6 All instruments for testing shall be provided by the AC contractor, these shall be as per Note 'A' of Appendix G. The accuracy of the instruments shall be as follows:
 - Temperature: Liquid in glass thermometer having accuracy ± 1 deg. C as per IS: 4825.
 - Wet bulb Temperature: Sling psychomotor conforming to IS:6017,
 - Scale Error: For less than 0 deg. $-0.3^{\circ}\text{C} \pm 0.2$ deg. C. For over 0°C $0.2^{\circ}\text{C} \pm 0.1$ deg.
 - Pressure Gauge: With the accuracy of $\pm 1\%$ for maximum scale value from 10 to 90%, and $\pm 1.9\%$ for maximum scale value for rest of the scale conforming to IS: 3695.
- Water flow meter' Water flow shall be measured using the arrangement installed as per schedule of work,
- 3.7 In case the tendering firms do not have testing instruments of the accuracy mentioned above, they should specify the accuracy of the instrument available with them for testing at the tender stage.

4. **Testing Requirements and Procedures:**

- 4.1 Balancing of all air and water systems and all tests as called for in the specification shall be earned out by the HVAC contractor in accordance with the specifications and relevant local codes if any. Performance tests of individual equipment and control shall be carried

out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence of Engineer-in-charge or his authorized representative.

The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy $\pm 0.5\%$. The instrument shall be capable of storing data and then downloading into a P.C. The HVAC contractor shall provide a minimum but not limited to the following instruments:

- Microprocessor based calculation meter to measure DB and WB temperature, RH and Dew point
- Velo meter to measure air volume and air velocity
- Pitot tube -Electronic rotary vane Anemometer
- Accubalance flow measuring hood

The contractor shall be responsible to provide necessary sockets and connections for fixing of the testing instruments, probes etc.

4.2 Air Systems

Systems are to be balanced by first adjusting the total flow at the fan, then by adjusting main dampers and branch dampers. Only final minor adjustments are to be made with register and diffuser dampers. Balancing of the air system shall be accomplished without causing objectionable air noise. Baffles and orifice plates required for proper air balance shall be furnished and installed by the contractor. Basically, the following tests and adjustments are required.

- Test all fan systems to provide proper cfm/ cmh.
- Adjust fresh air return air and exhaust dampers to provide proper air quantities in all modes of control.
- Test and record fresh air, return air and mixed air temperature at all air handling units. Test and record data at all coils after air and hydronic systems are balanced. Measure wet and dry bulb temperature on cooling coils.
- Make point tube transverse at all main supply and return ducts to set proper air quantities. Adjust all zone and branch dampers to proper cfm/cmh.
- Test and adjust each register, grills, diffuser or other terminals equipment to within 5% of design air quantity. Each opening shall be defined on the test report by size manufacturer's model, room location, design cfm and actual cfm. Outlets shall be adjusted to minimize objectionable drafts.
- Test and record static pressure drop across all filters and major coils.
- High velocity duct systems shall be tested for leakages. If excessive or audible leakage is detected, the defect shall be repaired by the contractor. Sufficient static pressure readings shall be taken from the air handling units to the terminal units to establish system static pressure.

4.3 Unit capacity in Tons Refrigeration shall be computed from the temperature readings, pressure readings and water/ brine flow measurements. Flow measurements shall be preferably through flow meters. Pumps shall be tested for the discharge head, flow and BHP. Where it is not possible to measure the flow, at least the discharge head and BHP (on the input side) shall be field tested.

4.4 Balancing Tolerance: Systems shall be balanced within the following tolerances

4.4.1	Duct leakage Rates (at operating pressures)	
	Low pressure ducts (0 to 0.5kPa)	5% of full flow
	Medium Pressure Ducts (0.5 to 3kPa)	1% of full flow
	High Pressure Ducts (Greater than 3kPa)	1% of full flow

4.4.2	Air flow rates	
	Under 70 L/S	10% of flow
	Over/ at 70 L/S	5% of flow

Procedure: -

- i) Review all pertinent plans, specifications, shop drawings and other documentation to become fully familiar with the systems and their specified and intended performance.
- ii) Furnish equipment and instruct sheet metal trade on proper use for conducting duct leakage tests. Conduct first test as a way of instructing the above trades in the presence of the Departments representative.
- iii) Test relative barometric pressures in various building area, as deemed necessary by the Department's representative and at least in an areas served by different systems.
- iv) Test performance and continuously record on a 24-hour basis, temperature and humidity levels where control equipment is provided for that purpose in certain critical areas.
- v) Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report shall be furnished by a qualified and authorized person.

4.5 **Reports**

Provide 3copies of the complete balancing and testing reports to the department. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified and safety measures provided as per Para 1.14.3.

4.6 **Final Documentation**

- i) The contractor shall leave the system operating in complete balance with water and air quantities as shown on drawings. Set stops on all balancing valves and lock all damper quadrants in proper position. Secure all automatic damper and valve linkages in proper positions to provide correct operating ranges. Proper damper positions shall be marked on ducts with permanent indication. Notify the department of any areas marginal or unacceptable system performance.
- ii) The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of lamination to the provisions of conditions of contract and design/ performance criteria.
- iii) Upon commissioning and final handover of the installation, the HVAC contractor shall submit (within 4 weeks) to the engineer-in-charge! department 6 (six) portfolios of the following indexed and bound together in hard cover ring binder (300 x 450 mm) in addition to the completion drawings as per Para 1.18.3.
 - a) Comprehensive operation and maintenance manual
 - b) Test certificates, consolidated control diagram and technical literature on all controls.

- c) Equipment warranties from manufacturers.
 - d) Commissioning and testing reports
 - e) Rating charts for all equipment
 - f) Log books as per equipment manufacturers standard format
 - g) List of recommended spares and consumables
 - h) Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.
- iv) At the close of the work and before issue of final certificate of completion by the Engineer-in-charge, the contractor shall furnish a written guarantee indemnifying the department against defective materials and workmanship for the Defects liability period. The contractor shall hold himself fully responsible for reinstallation or replace free of cost to the department.
- a) Any defective material or equipment supplied by the contractor
 - b) Any material or equipment supplied by the department which is proved to be damaged or destroyed as a result of defective workmanship by the contractor.

IX MODE OF MEASUREMENTS

1. Unit Prices in the Schedule of Quantities:

- 1.1 The item description in the schedule of quantities is in the form of a condensed resume. The unit price shall be held to include everything necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum total of all the individual item prices shall represent the total price of the installation ready to be handed over.
- 1.2 The unit price of the various items shall include the following:
- 1.2.1 All equipment, machinery, apparatus and materials required as well as the cost of any tests which the consultant may request in addition to the tests generally required to prove quality and performance of equipment.
 - 1.2.2 All the labour required to supply and install the complete installation in accordance with the specifications.
 - 1.2.3 Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the contractor to carry out his work.
 - 1.2.4 All the necessary measures to prevent the transmission of vibration.
 - 1.2.5 The necessary material to isolate equipment foundations from the building structure, wherever necessary.
 - 1.2.6 Storage and insurance of all equipment apparatus and materials.

- 1.3 The contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

2. **Measurements of Sheet Metal Ducts, Grilles/Diffusers etc.:**

2.1 **Sheet Metal Ducts**

- 2.1.1 All duct measurements shall be taken as per actual outer duct surface area including bends, tees, reducers, collars, vanes & other fittings. Gaskets, nuts, bolts, vibration rotation pads are included in the basic duct items of the BOQ.

- 2.1.2 The unit of measurements shall be the finished sheet metal surface area in metres squares. No extra shall be allowed for lapse and wastages.

- 2.1.3 All the guide vanes, deflectors in duct elbows, Branches, grille collars quadrant dampers etc. Shall be measured for actual sheet metal surface and paid for at the same rate as duct of same thickness.

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

2.2 **Grilles/Diffusers**

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

- 2.2.1 All measurements of grilles/diffusers shall be the Actual outlet size excluding the outer flanges.

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

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

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

3. **Measurements of Piping, Fittings, Valves, Fabricated Items:**

3.1 **Pipe**

(Including water piping, steam piping, oil piping, IP gas piping, air piping, vacuum piping) etc.

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

- 3.1.2 Exposing reinforcement in wall and ceiling and floor of possible and making good the same or installing anchor fasteners and inclusive of all items as specified in specifications and schedule of quantities.
- 3.1.3 Rates quoted shall be inclusive of providing and fixing Vibration pads and wooden pieces, wherever specified or required by the project coordinator.
- 3.1.4 Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowance being made for providing the same.
- 3.1.5 The length of the pipe for the purpose of payment will be taken through the centerline of the pipe and all fittings (e.g. Tees, bends, reducers, elbows, etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above for the fittings for valves and flanges, section 3.2 below applies.

3.2 **Valves and Flanges**

- 3.2.1 All the extra CI & cm flanged valves shall be measured according to the nominal size in mm and shall be measured by number. Such valves shall not be counted as part of pipe length hence deduction in pipe length will be made wherever valves occur.
- 3.2.2 All gun metal (gate & globe) valves shall include two Nos. of flanges and two numbers 150 mm long ms nipples, with one side threaded matching one of the valves, and other welded to the M.S. Slip-on-flange. Rate shall also include the necessary number of bolts, nuts and washers, 3 mm thick insertion gasket of required temp. grade and all items specified in the specifications.
- 3.2.3 The rates quoted shall be inclusive of making connections to the equipment, tanks, pumps etc. And the connection made with an installed pipeline shall be included in the rates as per the B.O.Q.

3.3 **Structural Supports**

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

4.2 **Pipes, Ducts & Vessels**

4.2.1 **Pipes**

The measurements for installation of piping shall be made in linear metres through all valves, flanges, and fittings. Pipes/ bends shall be measured along the centerline radius between tangent points. If the outer radius is R1 and the inner radius is R2. The centre line radius shall be measured as $(R1+R2)/2$. Measurement of all valves, flanges and fittings shall be measured

with the running metre of pipeline as if they are also pipe lengths. Nothing extra over the above shall be payable for insulation over valves, flanges and fittings in pipeline/ routings. Fittings that connect two or more different sizes of pipe shall be measured as part of the larger size.

4.2.2 **Ducts**

The measurements for insulation of ducts shall be made in actual square metres of bare uninsulated duct surface through all dampers, flanges and fittings. In case of bends the area shall be worked out by taking an average of inner and outer lengths of the bends. Measurements for the dampers, flanges, fittings shall be for the surface dimension for the connecting duct, nothing extra over the above shall be payable for insulation over dampers, flanges and fittings in duct routing.

4.2.3 **Vessels**

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

4.3 **Accessories Insulation**

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

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

4.4 **Acoustic Duct Lining**

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

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

4.5 **Roof and Wall Insulation & Acoustic Treatment**

4.5.1 The unit of measurement for all underdeck roof insulation, wall insulation, wall/roof acoustic panel shall be the uninsulated area of walls, roofs, to be treated, in square metres.

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

X **PIPING (SPLIT SYSTEM)**

1. **GENERAL**

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

2. **PIPING**

2.1 **Drain Piping:**

2.1.1 The drain piping shall be UPVC.

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

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

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

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

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

2.1.7 The drainpipe shall be insulated with two layers of nitrile rubber insulation.

2.1.8 Maximum pressure shall be 6 kgf.

2.2 **Copper Piping:**

2.2.1 Seamless soft copper tubing, type L shall be used to make connections to equipment, wherever required or specified.

2.2.2 Flare fittings e.g. flare nuts, tees, elbows, reducers etc. shall all be of brass.

2.3 **Refrigerant Piping:**

All refrigerant piping for the air conditioning system shall be constructed from soft seamless upto 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 jointing any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 20Kg per sq.cm and 10 Kg per sq.cm (low side). Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg and held for 24 hours.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than mentioned below:

<u>Pipe Size in mm(OD)</u>	<u>Wall Thickness in mm</u>
a) 41.3	1.3
b) 34.9	1.3
c) 28.6	1.2
d) 25.4	1.2
e) 22.2	1.0
f) 19.1	1.0
g) 15.9	1.0
h) 12.7	0.8
i) 9.5	0.8
j) 6.4	0.8

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.

3. **Pipe Insulation:**

a. Refrigerant Pipe Insulation

The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 19mm /13 mm thick elastomeric nitrile rubber as specified in BOQ.

b. Drain Pipe Insulation

Drain pipes carrying condensate water shall be insulated with 9 mm thick elastomeric nitrile rubber insulation.

For proper drainage of condensate, U Trap shall be provided in the drain piping (wherever required). All pipe supports shall be of prefabricated & pre painted slotted angle supports, properly installed with clamps etc.

XI LIST OF APPROVED 'MAKES'

S. No.	Items	Acceptable Makes
1.	Split Unit AC's	Daikin/LG/Mitsubishi/Samsung
2.	Pre/Fine filter	Mechmark/Thermodyne/Camfil
3.	Propeller fans	Airflow/Ostberg/Caryaire/Sphare
4.	Axial Fan	Krugar/Caryaire /Maico/Airflow
5.	Fresh Air Fan Section	Krugar/Caryaire /Maico/Airflow
6.	Inline fan	Airflow/Ostberg/Caryaire/Sphare
7.	Factory made duct	Zeco/Dustech/Ductofab/Asawa/Rollastar
8.	G.I. sheets	Tata/Sail/National/JSW/Jindal
9.	Back draft damper	Systemair/Caryaire/Mapro/Balance Air
10.	Louvers	Caryaire/Mapro/ Balance Air/Cynor
11.	Grilles/Volume Control Dampers	Caryaire/Systemair/Airflow/Cynor
12.	Starters/switchgear	Siemens/Larsen & Tubro/ABB
13.	Adhesive (Pipe, Duct etc.)	Pidilite/Cisbond/Cischem
14.	Push button starters	Siemens/ABB/L&T/Allen Bradley
15.	Power Cables & Control Cables	Havells/Polycab/KEI
16.	Auxiliary relays/contactors	Siemens/L&T/Cutler Hammer/Jyoti
17.	Line type fuse	Siemens/English electric/L&T
18.	Selector switches	Siemens/L&T/Kaycee
19.	Electrical panel	KEPL/RR Controls/Application/Advance
20.	Line type fuse	Siemens/English electric/L&T

S. No.	Items	Acceptable Makes
21.	Timer	Siemens/L&T/Cutler Hammer/English electric
22.	Copper Refrigerant piping	Shri Shyam/Rajco/Mandev/Mehta Tubes
23.	UPVC Pipe	Prakash/Surya/Polypack/Prince/Supreme
24.	Nitrile Rubber	Armacell/K-flex/Aerocell/Aeroflex
25.	Expanded polystyrene	SHI/Beardshell/Styrene Packaging
26.	PUF insulation	Lloyd/Malanpur
27.	Vibration isolator pads	Resistoflex / Kanwal
28.	Paracoat BPC	Paramount / Pidilite
29.	Cable/Pipe Tray	Feders Lloyd/MEM/Profab/RICO
30.	Fastners & fittings etc	Wurth/Hilti/Rawplug/Mongue
31.	Welding rod	Adon/Essar/Advani/Ejab
32.	Paint	Nerolac/Asia/Berger

XII TEST PROFORMA

<u>S.No.</u>	<u>Item</u>	<u>Unit</u>	<u>Test Result</u>
1.	<u>Operating Conditions:</u>		
1.1	Ambient conditions		
	-Temp. D.B.	O C	
1.2	-Temp. W.B.	O C	
1.3	-R.H.	%	
2.	<u>Pumps:</u>		
2.1	Impeller dia	mm	
2.2	Speed	rpm	
2.3	Water pressure -Entering	mmHg.	
2.4	Water pressure -Leaving	mmHg.	
2.5	Water flow rate specified	LPM	
2.6	Water flow rate computed	LPM	
2.7	Motor rating	kw	
2.8	Motor current at full load	Amps	
2.9	Fan motor voltage	Volts	
2.10	Fan motor speed	RPM	
3.	<u>Axial/Propeller/Blower/Inline Fans :</u>		
3.1	Air quantity		
3.2	Rated capacity	kw	
3.3	Rated voltage	Volts	
3.4	Rated current	Amp	
3.5	Current rating (Actual)	Amp	

4. Controls:

Report on test and functioning of all controls.

Notes:**Test Instructions:**

1. All instruments for testing shall be provided by the HVAC contractor.
2. Thermometer used for measurement of temperature of water/refrigerant shall have graduations of 0.1°C and shall be got calibrated from N.P.L. or any recognized test house before hand.
3. Thermometers used in the psychrometers shall have graduations of 0.2°C and shall be calibrated as at (2) above.
4. Pressure gauges shall also be got calibrated beforehand from a recognized test houses.
5. Orifice type of flow meters shall be used for measuring flow rate through the condensers and chillers.
6. Wherever the flow rate vs. pressure drop curves for the heat exchangers of the same mode, as installed, certified by project coordinator on the basis of tests conducted at manufacturer's works are produced, flow meters for measuring water flow rate through these may not be provided. Actual water flow shall in such a case, be computed with reference to these curves and the actual pressure drop measured at site.
7. Integrating type flow meters may be used for measuring water flow through the individual air handling units.
8. Air flow rates shall be measured in the supply duct using pitot tube.

<<<END OF VOLUME II >>>