

Tender No. SBI/AMR/P&E/2025-26/08/12

29.08.2025



STATE BANK OF INDIA

NAME OF THE WORK: - CONSTRUCTION OF BUILDING FOR AO, SBILD & OTHER OFFICE'S AT TIRUPATI IN EPC MODE.

Part E

TECHNICAL SPECIFICATION

CLIENT

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SECTION – 1 TECHNICAL SPECIFICATIONS**1.1 GENERAL:**

This specification shall be read in conjunction with the latest, IS specifications. In case these specifications are found wanting in any way the relevant CPWD Specifications shall apply.

1.2 MATERIALS TO BE APPROVED/BEST QUALITY:

All the materials employed in connection with the permanent work, shall be new and the best of its kind. All materials shall be in accordance with these specifications and shall be as approved by the PMC/ BANK.

1.3 STANDARDS:

Except where otherwise specified and permitted by the Architect, all materials shall conform to the latest edition of Indian standard specification.

Section - II**1.4 Indian Standards**

All relevant Standards as specified elsewhere in this Volume are applicable. Frequency of testing of various materials shall be strictly as per latest IS codes.

Indian Standards to be followed are:

SP : 64 : 2001	IS code for Design Loads	Explanatory Handbook on Indian Standard Code of practice for Design Loads (Other than Earthquake) for Buildings and Structures
IS : 2430 : 1986	IS code for aggregate sample	Methods for Sampling of Aggregates for Concrete
IS : 2116 : 1980	IS code for Sand	Sand for masonry Mortars - Specifications
IS : 2250 : 1981	IS code of cement mortar for Masonry	Code of Practice for Preparation and Use of Masonry Mortars
IS : 8112	IS code for OPC 43 grade Cement	Specification for 43 grade OPC
IS : 10510	IS code for Vee bee test	Specification for vee bee consistometer
IS : 12269	IS code for OPC 53 grade Cement	Specification for 53 grade OPC
IS : 455	IS code for PSG cement	Specification of Portland Slag Cement
IS : 6909	IS code for SRC cement	Specification for Super sulphated Cement

IS 4031-1996 Part-1	IS code for fineness of cement	Methods of physical tests for hydraulic cement - Determination of fineness by dry sieving
IS 4031-1996 Part-2	IS code for fineness of cement Test	Methods of physical tests for hydraulic cement - Determination of fineness by specific surface by Blaine air permeability method
IS 4031-1996 Part-3	IS code for cement soundness test	Methods of physical tests for hydraulic cement - Determination of soundness
IS 4031-1996 Part-4	IS code for consistency of cement test	Methods of physical tests for hydraulic cement - Determination of consistency of standard cement paste
IS 4031-1996 Part-5	IS code for initial and final setting time of cement	Methods of physical tests for hydraulic cement - Determination of initial and final setting times
IS 4031-1996 Part-6	IS code flexural strength test for mortar	Methods of physical tests for hydraulic cement - Determination of compressive strength of hydraulic cement (other than masonry cement)
IS 4031-1996 Part-7	IS code for Hydraulic cement test	Methods of physical tests for hydraulic cement - Determination of compressive strength of masonry cement
IS 4031-1996 Part-8	IS code for compressive strength of cement mortar	Methods of physical tests for hydraulic cement - Determination of transverse and compressive strength of plastic mortar using prism
IS 4031-1996 Part-9	IS code heat of hydration test of Cement	Methods of physical tests for hydraulic cement - Determination of heat of hydration
IS 4031-1996 Part-10	IS code for Shrinkage test of cement	Methods of physical tests for hydraulic cement - Determination of drying shrinkage
IS 4031-1996 Part-11	IS code for Cement Density Test	Methods of physical tests for hydraulic cement - Determination of density
IS 4031-1996 Part-12	IS code for Hydraulic cement mortar	Methods of physical tests for hydraulic cement - Determination of air content of hydraulic cement mortar
IS 4031-1996 Part-13	IS code for Water Retentively of Masonry	Methods of Physical Tests for Hydraulic Cement - Measurement of Water

	Cement	Retentivity of Masonry Cement
IS 4031-1996 Part-14	IS code for Hydraulic cement	Methods of physical test for hydraulic cement - Determination of false set
IS 4031-1996 Part-15	IS code for cement fineness test by wet sieving	Methods of physical test for hydraulic cement - Determination of fineness by wet sieving
IS : 650	IS code for Sand test for Cement	Specification for Standard sand for testing of Cement
IS : 383	IS code for coarse aggregate for concrete	Specification for Coarse and Fine aggregate for use in mass concrete
IS : 2387	IS code for aggregate test	Method of test for aggregates for concrete.
IS : 516	IS code for compressive strength of concrete cube test	Methods of test for strength of concrete.
IS : 8041	IS code Rapid hardening cement	Specification for Rapid Hardening cement
IS : 12330	IS code for Sulphate resistant cement	Specification for Sulfate Resisting cement
IS : 6452	IS code for HAC cement	Specification for High Alumina cement (HAC)
IS : 12200	IS code for PVC pipe	Specification of PVC Water tubes
IS : 13311 Part 1	IS code for Ultrasonic test	Method of Non-destructive testing of concrete - Ultrasonic pulse velocity
IS : 13311 Part 2	IS code rebound hammer test	Method of non-destructive testing of concrete-methods - Rebound hammer
IS : 1077	IS code for Burt Clay Bricks	Specification of common Burnt Clay Bricks for Building
IS : 5454	IS code for clay bricks	Methods of sampling of clay building bricks
IS : 3495 : 1992	IS code for Brick Test	Methods of Tests of burnt Clay Bricks
SP : 16 : 1980	IS code for concrete	Design of Reinforced Concrete
SP : 24 : 1983	IS code for concrete	Explanatory Handbook on Indian Standard Code of Practice for Plain and Reinforced Concrete

SP : 34 : 1987	IS code for concrete	Handbook on Concrete Reinforcement and Detailing
IS : 14858	IS code for CTM machine	Requirements for compression testing machine used for testing of concrete and mortar
SP : 23 : 1982	IS code for concrete Mix design	Handbook on Concrete Mixes
IS : 1199	IS code for Slump Test	Methods of sampling and analysis of concrete
IS : 3025	IS code for Water in construction	Methods of sampling and test (physical and chemical) for water used in industry.
IS : 432	IS code for Fencing wire work	Specification for Mild steel and medium tensile bars and hard drawn steel wire.
IS : 1139	IS code for Steel Reinforcement	Specification for hot rolled mild steel, medium tensile steel and high yield strength steel deformed bars for concrete reinforcement.
IS : 1566	IS code for Steel Reinforcement	Specification for plain hard drawn steel wire fabric for concrete reinforcement
IS : 1785	IS code for Steel Reinforcement	Specification for plain hard drawn steel wire for prestressed concrete
IS : 1786	IS code for Steel Reinforcement	Specification for cold twisted steel high strength deformed bars for concrete reinforcement.
IS : 303	IS code for Plywood	Specification for Plywood for general purposes
IS : 4990	IS code concrete shuttering & formwork	Specification for plywood for concrete shuttering work
IS : 4991	IS code for blast resistant design of structure	Criteria for Blast Resistant Design of Structures for Explosions Above Ground
Is : 2645	IS code for Water Proofing compounds	Specification for integral cement water proofing compounds
IS : 1791	IS code for concrete vibrator	Specification for batch type concrete mixers
IS : 2505	IS code for concrete vibrator	Specification for concrete vibrators , immersion type

IS : 2506	IS code for concrete vibrator	Specification for screed board concrete vibrator
IS : 2514	IS code for concrete vibrator	Specification for concrete vibrating tables
IS : 4656	IS code for vibrators	Specification for form vibrators
IS : 2722	IS code for batch mixer for concrete	Specification for portable swing weigh batchers for concrete (single & double bucket type)
IS : 2750	IS code for Scaffolding work	Specification for steel scaffoldings.
IS : 456	IS code for concrete	Code of practice for plain and reinforced concrete
IS : 1343	IS code for Prestressed concrete	Code of practice for prestressed concrete
IS : 9399	IS code for flexural test of concrete	Apparatus for flexural testing of concrete -Specification
IS : 457	IS code for Dam	Code of practice for general construction of plain and reinforced concrete for dams and other massive structures.
IS : 3370 : Part 1	IS code for water tank design	Code of practice Concrete structures for the storage of liquids - General requirements
IS : 3370 : Part 2	IS code for RCC water tank design	Code of Practice Concrete structures for the storage of liquids - Reinforced concrete structures
IS : 3370 : Part 3	IS code for Prestressed concrete Water tank Design	Code of Practice Concrete structures for the storage of liquids - Prestressed concrete structures
IS : 3370 : Part 4	IS code for water tank design tables	Code of practice for concrete structures for the storage of liquids - Design tables
IS : 3935	IS code for Prefabricated Structure	Code of practice for composite construction
IS : 3201	IS code for Precast concrete Trusses	Criteria for design and construction of precast concrete trusses.
IS : 2204	IS code for Reinforced concrete	Code of practice for construction of reinforced concrete shell roof
IS : 2210	IS code for Folded Plate	Criteria for the design of R.C. shell structures and folded plates.

IS : 2751	IS code steel structure design	Code of practice for welding of mild steel structures are folded plates
IS : 2502	IS code for bar bending schedule	Code of practice for bending and fixing of bars for concrete reinforcement
IS : 3558	IS code for Immersion Vibrators	Code of practice for use of immersion vibrators for consolidating concrete
IS : 3414	IS code for joints in buildings	Code of practice for design and installation of joints in buildings
IS : 2571	IS code for concrete flooring	Code of practice for laying in situ cement concrete flooring
IS : 73	IS code for paving bitumen	Specification for paving Bitumen
IS : 277	IS code for GI sheet	Galvanized steel sheets (plain and corrugated)
IS : 651	IS code for stoneware pipe	Glazed stoneware pipes and fittings
IS : 702	IS code for bitumen material	Specification for industrial bitumen
IS : 1200	IS code for measurements in civil engineering	Method of measurements of building and civil engineering works: Ceiling & Lining
IS : 1729	IS code for Drain water pipe	Cast iron Drain water pipes and fitting
IS : 2095 PART 1	IS code for Brick bat coba Flat roof finish	Gypsum plaster boards (Pt.1) plain Gypsum plaster boards
IS : 2115	IS code for flat roof finish	Code of practice for flat roof finish: mudphuska
IS : 2633	IS code for testing Zinc Plate	Method of testing uniformity of coating on zinc Coated articles
IS : 2645	IS code for waterproofing work	Specification for integral water proofing compounds for cement mortar & concrete
IS : 3007 PART 1	IS code for asbestos cement sheet	Code of practice for laying of asbestos cement sheets - corrugated sheets
IS : 3007 PART 2	IS code for corrugated sheet	Code of practice for laying of asbestos cement sheets - Semi corrugated sheets
IS : 3087	IS code for wood materials	Particle boards of wood and other ignocellulogic materials (medium density) for general purposes - specifications
IS : 3144	IS code for Thermal	Methods of test for mineral Wool thermal

	Insulation Test	insulation materials
IS : 3346	IS code for Thermal Insulation Material	Method of the determination of thermal conductivity of thermal insulation materials
IS : 3348	IS code for Fibre Insulation boards	Specification for fibre insulation boards
IS : 3384	IS code waterproofing material	Specification for bitumen primer for water proofing and damp proofing
IS : 4671	IS code for Polystyrene	Expanded polystyrene for thermal insulation purposes
IS : 5382	IS code for sewers	Specification for rubber sealing rings for gas mains, water mains and sewers
IS : 10192	IS code for SRBGF	Specifications for synthetic resin bonded glass fibre (SRBGF) for electrical purposes.
IS : 13592	IS code for UPVC pipe	Unplasticized polyvinyl chloride (UPVC) pipes for soil and Waste discharge system for inside and outside building.
IS : 15988	IS code for seismic analysis	Guidelines for Seismic Evaluation and Strengthening of Existing Reinforced Concrete Buildings
IS : 14753	IS code for PMMA sheets	Specifications for polymethyl Methacrylate (PMMA) (Acrylic) sheets
IS : 14862	IS code for Fibre flat sheet	Fibre cement flat sheets - specifications
IS : 14871	IS code Fibre corrugated Sheet	Specifications for products in fibre reinforced cement - Long corrugated
IS : 1795	IS code for Pillar taps	Specification for pillar taps for Water supply purposes.
IS : 2548 PART 1	IS code ceramic seats	Plastic Seats and Covers for Water closets Part 1: Thermo Set Seats and covers - Specifications
IS : 2548 PART 2	IS code for Water closets	Plastic seats and covers for water closets Part 2: Thermoplastic seats and covers.- Specifications
IS : 2556 PART 1	IS code for sanitary appliances	General requirements vitreous sanitary appliances

IS : 2566 PART 2	IS code for Water closets	Specific requirements of Wash-down water closets.
IS : 2556 PART 3	IS code for Squatting Pans	Specific squatting pans.
IS : 2556 PART 4	IS code for Washbasins	Specific requirements of Washbasins.
IS : 2556 PART 5	IS code for laboratory sinks	Specific requirements of laboratory Sinks.
IS : 2556 PART 6	IS code for Urinals	Specific requirements of Urinals & Partition plates
IS : 2556 PART 7	IS code for Sanitary Fittings	Specific requirements of accessories for sanitary appliances
IS : 2556 PART 14	IS code for integrated squatting pans	Specific requirements of integrated squatting pans.
IS : 2556 PART 15	IS code for universal water closets	Specific requirements of universal water closets.
IS : 2963	IS code for copper alloy waste fittings	Specification for Copper alloy waste fittings for Wash basins and Sinks.
IS : 3076	IS code for short link chain	Short Link Chain for Lifting Purposes
IS: 10297 - 1982	IS code for precast reinforced cement concrete	Design and Construction of Floors and Roofs using Precast Reinforced/ Prestressed Concrete Ribbed or Cored Slab units.
IS: 6006-1983	IS code for Prestressed concrete	Uncoated Stress relived Strand for Prestressed concrete
IS: 8520 : 1977	IS code industrial safety equipment's	Guide for selection of industrial safety equipment for eye, face and ear protection.
IS: 8519 " 1977	IS code for safety	Guide for selection of industrial safety equipment for body protection
IS: 6313 (Part-3) 1981	IS code for anti-termite treatment	Anti-Terminate measures in buildings Part-III Treatment for existing buildings
IS: 1080: 1985	IS code for shallow foundations	Shallow foundations in soils (other than Raft, Ring and Shell)

IS: 822 : 1970	IS code for Welding Inspection	Inspection of welds
IS: 8009 (Part-I) - 1976	IS code for foundation settlements	Calculation of settlements of foundations.
IS: 1904:1986	IS code for foundation soils	Design and Construction of foundations in soils
IS: 383 :1970	IS code for aggregates	Coarse and fine aggregates from natural sources for concrete.
IS: 6403 : 1981	IS code for safe bearing capacity of soil	Determination of bearing capacity of shallow foundations
IS: 6313 (Part-1) 1981	IS code for measurements of Anti Termite Treatment	Code of Practice of Anti-Termite measurement
IS: 6313 (Part-2) 1981	IS code for measurements of Anti Termite Treatment	Anti-Termite measures in buildings
IS: 10042 : 1981	IS code for Soil Investigation	Site Investigations for foundation in gravel " boulder deposit.
IS: 280 - 1978	IS code for reinforcement binding wire	Mild Steel wire for general engineering purposes.
IS: 432 (Part-I) 1982	IS code for concrete reinforcements	Mild Steel and medium tensile steel bars and hard " drawn steel wire for concrete reinforcement
IS: 9143 - 1979	IS code unconfined compressive strength of rock	Determination of unconfined compressive strength of rock materials
IS: 10379 - 1982	IS code soil embankments	Field control of moisture and compaction of soils for embankment and subgrade
IS: 1489 (Part-1)1991	IS code for PPC Cement	Portland " Pozzolana cement " specification (Fly Ash based)
IS: 1489 (Part-2)1991	IS code for PPC Cement	Portland " Pozzolana cement " specification (calcined clay based)
IS : 12118 Part 1	IS code sealants	Specifications for Polysulphide sealants - General Requirements
IS : 12118 Part 2	IS code sealant test	Specifications for Polysulphide sealants - Methods of Test

IS: 7272 (Part - 1) 1974	IS code for labour productivity	Labour output constants for building work (north zone)
IS: 8142 - 1976	IS code for concrete setting time	Determining setting time of concrete by penetration resistance
IS: 4984 : 1995	IS code for HDPE Pipe	High Density Polyethylene pipes for water supply - specification
IS: 1477 (Part-1) 1971	IS code for Structural Steel painting	Painting of Ferrous metals in buildings (Pretreatment)
IS: 1477 (Part-2) 1971	IS code for Structural Steel painting	Painting of Ferrous metals in buildings (Painting)
IS: 4000 : 1992	IS code for anchor bolts and nuts	Code of Practice for High Strength Bolts in Steel Structures
IS: 4014 : 1967 Part 1	IS code for scaffolding design	Code of practice for steel tubular, scaffolding
IS: 4014 1967 Part 2	IS code for scaffolding material	Steel Tubular Scaffolding (Definitions and materials)
IS : 9012	IS code for shotcrete concrete	Recommended practice for shotcreting
IS: 9013: 1978	IS code for accelerated curing of concrete	Method of making, Curing and determining compressive strength of accelerated-cured concrete test specimens.
IS: 14268 : 1995	IS cod for prestressed concrete specification	Uncoated stress relieved low relaxation seven-ply strand for prestressed concrete-specification.
IS: 9595 : 1996	IS code metal arc welding	Metal “ Arc welding of carbon and carbon manganese steels “ recommendation.
IS: 2911 (Part-4) 1985	IS code for Pile Load test	Design and construction of Pile foundations (Load Test on Piles)
IS: 459-1992	IS code for cement sheets	Corrugated and Semi-corrugated Asbestos Cement sheets specification.
IS: 2062-1992	IS code structural Steel Design	Steel for General Structural purposes- specification

IS: 4082-1996	IS code for construction materials	Stacking and storage of construction materials and components at site-recommendations.
IS: 801-1975	IS code for cold formed steel structure	Use of cold-formed light Gauge steel structural members in general building construction.
IS : 802 Part 1	IS code for Transmission Line Towers material selection	Code of Practice for Use of Structural Steel In Overhead Transmission Line Towers
IS : 802 Part 2	IS code for Transmission Line Towers Work	Code of Practice for Use of Structural Steel In Overhead Transmission Line Towers - Fabrication, Inspection
IS : 803 : 1976	IS code for Oil tanks	Code of Practice for Design Fabrication and. Erection of Vertical Mild Steel Cylindrical Welded Oil. Storage Tanks
IS : 804 : 1967	IS code for rectangular oil tank	Rectangular pressed steel tanks - Specifications
IS :805 : 1968	IS code for steel water tanks	Code of Practice for Use of Steel in Gravity Water Tanks
IS : 806 : 1968	IS code for steel tube	Code of Practice for Use of Steel Tubes In General Building Construction
IS : 807 : 2006	IS code for cranes and hoists	Code of Practice for Design, erection and testing (structural portion) of cranes and hoists
IS 808 : 1989	IS code for angle sections	Dimensions for hot rolled steel beam, column, channel and angle sections
IS : 811 : 1987	IS code for Structural Steel section	Cold formed Light Gauge Structural Steel Sections - Specifications
IS : 8229	IS code for Oil well cement	Oil Well Cement Specification
IS:2720 (part-17) 1986	IS code for Permeability test of soil	Methods of test for soils (part-17) Laboratory Determination of Permeability.
IS:2720 (part-29) 1986	IS code for Soil Test	Methods of test for soils - determination of dry density of soils in-place by the core-cutter method

IS: 4326-1993	IS code for Earthquake resistant building design	Earthquake Resistant Design and Construction of Buildings
IS: 15284 (Part-1) 2003	IS code for Stone columns	Design and construction for ground Improvement-guidelines-part 1 (stone columns)
IS: 4985 : 2000	IS code for water pipe	Unplasticized PVC Pipes for Potable water supplies " specification
IS: 3103 - 1975	IS code for industrial ventilation	Industrial Ventilation
IS: 2470 (part-1) 1985	IS code for septic tank design & soak pit	Installation of Septic Tanks (Part-1) Design criteria and construction
IS: 875 (part-4) 1987	IS code for Snow Load	Design loads (other than earthquake) for buildings and structures (part-4) snow loads.
IS: 875 (part-2) 1987	IS code for Imposed Load	Design loads (other than earthquake) for buildings and structures (part-4) - Imposed Loads
IS: 7317-1993	IS code for uniaxial test for rock	Uniaxial Jacking Test for modules of Deformation of rock.
IS: 2440:1975	IS code for light for buildings	Daylighting of Buildings
IS: 7861 (Part-1) 1981	IS code for cod weather concrete	Extreme weather concreting (Part " 1) recommended Practice for cold weather concreting.
IS : 8042	IS code for white cement	Specifications of White Cement
IS: 3812 - 1981	IS code for Fly ash in concrete	Specification for Fly ash for use as pozzolana and Admixture.
IS : 8043	IS code for Hydrophobic cement	specifications of Hydrophobic Cement
IS:2911 (Part-1) Sec I)-1979	IS code for bored cast in situ piles	Design and construction of Pile foundations (part " 1) concrete piles section : Driven Cost in situ concrete piles.
IS:2911 (Part -2) Sec I)-1979	IS code Pile design	DESIGN AND CONSTRUCTION OF PILE FOUNDATIONS " CODE OF

		PRACTICE
IS: 9103 - 1999	IS code for concrete admixture	Concrete Admixtures " Specification.
IS: 269 : 1989	IS code for OPC 33 grade Cement	Ordinary Portland Cement, 33 grade-specification.
IS: 10262 - 1982	IS code for concrete mix design	Recommended Guidelines for concrete mix design.
IS: 3770 1965	IS code for liquid storage structure	Concrete structure for the storage of liquids (Part-1 & 2)
SP-7: 1983 (Part-4)	IS code National Building code of India	National Building code of India -1983
IS - 8329 : 2000	IS code DI pipe	Centrifugally cast (span) ductile Iron pressure Pipes for water, gas and Sewage-Specification.
IS - 1254 : 1991	IS code for Aluminum Sheet	Corrugated Aluminum Sheet " Specification.
IS : 5513	IS code for Vicat Apparatus	Specification for vicat apparatus
IS : 5514	IS code for Le-Chatlier Test	Specification of Apparatus Used in 'Le-chatelier' Test
IS : 5515	IS code for compacting factor apparatus	Specification of Compacting Factor Apparatus
IS : 3466	IS code for masonry cement	Specification Masonry Cement
IS:875 (Part-1) - 1987	IS code for Dead Load	Dead loads " Unit weights of building materials and stored materials.
IS: 1893 (Part -1) 2002	IS code earthquake resistance structures	Criteria for Earthquake Resistant Design of Structures - Buildings
IS: 13072 ; 1991	IS code for Hexafluoride	Sulphur Hexafluoride for Electrical purposes " Specification
IS: 11973-1986	IS code embankments	Treatment of rock foundations, core and abutment contacts with rock, for embankment dams
IS: 12955 (Part-1) 1990	IS code for testing rock mass	Code of practice for in-situ determination of rock mass deformability using a flexible dilatometer - volume change
IS: 12955 (Part-2)	IS code for Radial	Code of practice for in-situ determination

1990	displacement test	of rock mass deformability using flexible dilatometer - Radial displacement
IS: 13365 (Part-2) 1992	IS code for rock classification	Quantitative classification systems of rock mass " guidelines
IS: 2911 (Part -3) 1980	IS code for under reamed piles	Design and construction of pile foundations (Under-Reamed piles)
IS: 2132-1986	IS code for sampling soils	Thin welded tube sampling of soils
IS: 1641 - 1988	IS code for Fire Safety	Fire safety of building (General)
IS: 4926 : 2003	IS code for Ready Mixed concrete	READY-MIXED CONCRETE — CODE OF PRACTICE
IS : 15388	IS code for Silica Fume	Specification for Silica Fume
IS: 14687: 1999	IS code for False work concrete	False work for Concrete Structures " Guidelines
IS : 12600	IS code for Low heat cement	Specification of Low heat Cement
IS : 1193	IS code for vibrators	Code of Practice for use of Screed Board Concrete Vibrators
IS: 10589 -1983	IS code for soils	Specification for equipment for subsurface sounding of soils
IS : 4967 : 1968	IS code for Seismic instrumentation	Recommendations for Seismic Instrumentation for River Valley Projects
IS: 800 : 2007	IS code for Steel	General construction in steel
IS: 3443 - 1980	IS code for rail sections	Specification for Crane rail sections
IS : 6922	IS code for blast resistance design	Criteria for Safety and Design of Structures Subject to Underground Blasts
IS: 2386 (Part-1 -4) 1963	IS code for aggregates Test for concrete	Test for Aggregates for concrete
IS : 14959 Part 1	IS code for mortar & concrete	Method of Test determination of water soluble and acid soluble chlorides in mortar and concrete - Fresh mortar and concrete
IS : 14959 Part 2	IS code for chlorides in Water for concrete	Method of Test determination of water soluble and acid soluble chlorides in mortar and concrete - Hardened mortar and concrete

IS : 13827	IS code for earthwork resistance design for earthen buildings	Improving Earthquake resistance of Earthen Buildings
IS : 13828	IS code for earthwork resistance design for Masonry buildings	Improving Earthquake resistance of Masonry Buildings
IS : 13920	IS code for ductile detailing	Ductile detailing of Reinforced concrete structures subjected to Seismic forces
IS: 3043 - 1987	IS code for Earthing	Code of practice for earthing
IS : 13935	IS code for Repair & Rehabilitation of buildings	Guidelines for Evaluation, Repair and Seismic Strengthening of Masonry Buildings
IS: 3419 - 1989	IS code for rigid nonmetallic conduits	Fittings for rigid non- metallic conduits
IS: 14900 - 2000	IS code for Glass	Transparent float glass
IS: 811 - 1987	IS code for light gauge structural steel sections	Cold formed light gauge structural steel sections
IS: 2026 (Part 2) 1977	IS code for Power Transformer	Power Transformers, Part-II Temperature - Rise
IS: 2026 (Part 3) 1977	IS code for Transformer Installation	Power Transformers - INSULATION LEVELS, DIELECTRIC TESTS AND EXTERNAL CLEARANCES IN AIR
IS: 9537 (Part I) 1980	IS code for electrical conduits	Conduits for Electrical Installations (General Requirements)
IS : 12089	IS code for PSC Cement	Specification for granulated slag for the Manufacture of Portland Slag Cement (PSC)
IS: 694 - 1990	IS code for cable	PVC Insulated cables for working voltages up to and in including 1100 volts
IS: 7098 (Part-1) 1988	IS code for PVC sheathed cables	Cross linked polyethylene insulated PVC sheathed cables.
IS: 732 - 1989	IS code for electrical wiring Installation	Electrical Wiring installations
IS: 1391 (part 1) 1992	IS code for Unitary air conditioners	Room Air Conditioners -Unitary Air Conditioner

IS: 1391 (part 2) 1992	IS code for Split AC	Room Air Conditioners - Split Air Conditioners
IS: 2720 (Part 1) 1983	IS code for Dry Density Soil	Methods of test for soils - Dry Soil
IS: 2720 (Part 8) 1983	IS code for soil tests	Methods of test for soils
IS: 2720 (Part 14) 1985	IS code for cohesion less Soil	Methods of test for soils - Cohesion less Soil
IS: 2720 (Part 29) 1985	IS code for core cutter method	Methods of test for soils - DETERMINATION OF DRY DENSITY OF SOILS IN-PLACE BY THE CORE-CUTTER METHOD
IS: 2190 : 1992	IS code for Fire extinguishers	Selection, Installation and maintenance of first-aid fire extinguishers
IS: 12070 - 1987	IS code for shallow foundation design	Design and construction of shallow foundations on rocks
IS: 1554 (Part 1) 1988	IS code heavy duty cable	PVC insulated (Heavy Duty) Electric Cables
IS: 1172 - 1993	IS code drainage Work	Basic requirements for water supply, drainage and sanitation
IS: 2064 : 1993	IS code for Sanitary works	Selection, Installation and maintenance of sanitary appliances
IS: 2026 (Part- 5) 1994	IS code for Power Transformer	Power Transformers
IS: 2026 (Part - 8) 1994	IS code for	Power Transformers - Application Guide
IS : 6533 : 1989 (Part 1)	IS code for Steel chimney	Code of Practice for Design and Construction of Steel Chimneys - Mechanical aspects
IS : 6533 : 1989 (Part 2)	IS code for steel structural chimney	Code of Practice for Design and Construction of Steel Chimneys - Structural aspects (first revision)
IS: 2026 (Part 1) 1977	IS code for power transformer test	Specification for power transformers (Insulation, Levels, Dielectric tests)
IS: 10028 (Part 1) 1981	IS code for power transformer selection	Selection, installation and maintenance of transformers - Selection

IS: 10028 (Part 2) 1981	IS code for power transformer installation	Selection, installation and maintenance of transformers (Installation)
IS: 2950(Part 1) 1981	IS code for Raft foundation design	Design and construction of raft foundations (Design)
IS 7205:1974	IS code for safety work	Safety Code for Erection of Structural Steel Work
IS 7215:1974	IS code for tolerance for steel structure	Tolerances for Fabrication of Steel Structures
IS: 4885 - 1988	IS code for sewer bricks	Specification for Sewer Bricks
IS : 10987	IS code for petroleum tank	Code of Practice for Design, Fabrication, Testing & Installation of Underground Horizontal Cylindrical Storage Tanks for Petroleum Products
IS: 2974 (Part 1) 1982	IS code for Machine foundation	Design and construction of machine foundations
IS: 908 - 1975	IS code for Fire hydrant system	Fire Hydrant, Stand Post Type
IS: 4631 - 1986	IS code for epoxy resin	Laying of Epoxy resin floor toppings
IS: 5491 - 1969	IS code for granolithic flooring	Laying in Situ granolithic concrete floor topping
IS: 4971 - 1968	IS code for finishing works	Selection of Industrial floor finishes
IS: 1255 - 1983	IS code for power cable	Installation and maintenance of power cables up to and including 33 kv
IS: 2792-1964	IS code for Stone slab	Design and construction of stone slab over joist floor
IS: 1888-1992	IS code for Plate load test	Method of Load Test on Soils
IS: 7098 (Part-2) 1988	IS code for PVC sheathed cables	Cross linked polyethylene insulated PVC sheathed cables - FOR WORKING VOLTAGES FROM 3.3 kV UP TO AND INCLUDING 33 kV
IS: 7861 (Part-2) 1981	IS code for weather concrete	"Extreme weather concreting (Part II) recommended Practice for cold weather concreting."
IS: 783 - 1985	IS code RCC Hume Pipe	Laying of Concrete Pipes
IS : 13757	IS code for Fly Ash bricks	Burnt clay fly ash building bricks-

		Specification
IS : 2212	IS code for Brick Masonry Wall	Code of practice for brick work deals with the construction of clay brick masonry
IS : 13757	IS code for Fly Ash Cement brick	Burnt clay fly ash building bricks- Specification
IS : 3495 : 1992	IS code for Compressive strength Bricks Test	Methods of Tests of burnt Clay Bricks
IS : 3495 : 1992	IS code for water absorption test for Brick	Methods of Tests of burnt Clay Bricks
IS : 1200	IS code for brickwork measurement	Method of measurements of building and civil engineering works: Ceiling & Lining
IS : 1077	IS code for classification of Bricks	Specification of common Burnt Clay Bricks for Building
SP : 20	IS code for brick masonry design	Handbook on Masonry Design and Construction [Building Construction Practices including Painting, Varnishing and Allied Finishing]
IS : 1905	IS code for brick masonry structures	Code of Practice for Structural use of Unreinforced Masonry [Building Construction Practices including Painting, Varnishing and Allied Finishing]
IS : 1077	IS code for Wire cut Brick	Specification of common Burnt Clay Bricks for Building
IS : 456	IS code for Self compacting concrete mix design	Code of practice for plain and reinforced concrete
SP : 23 : 1982	IS code for design mix of concrete	Handbook on Concrete Mixes
IS : 456	IS code for RCC	Code of practice for plain and reinforced cement concrete
IS : 2720 Part 3 Section 1	IS code for specific gravity of Soil Test	Determination of specific gravity, Section 1: Fine grained soils
IS : 2720 Part 3 Section 2	IS code for Soil & Foundation	Determination of specific gravity, Section 2: Fine, medium and coarse grained soils [CED 43: Soil and Foundation Engineering]

IS : 1661	IS code for plastering sand	Code of Practice of Cement Sand mix
IS: 4923	IS code for Structural Steel Weight	Hollow steel sections for structural use - Specification [MTD 19: Steel Tubes, Pipes and Fittings]
IS : 816	IS code for structural steel welding arc	Code of practice for use of metal arc welding for general construction in mild steel [MTD 12: Welding Applications]
IS: 14343	IS code for Cement grouting	Choice of grouting materials for alluvial grouting - Guidelines
IS: 5878 Part 7	IS code for Consolidation grouting	Code of practice for construction of tunnels conveying water, Part 7: Grouting [WRD 14: Water Conductor Systems]
IS : 2751	IS code for Steel Structure	Code of practice for welding of mild steel structures and folded plates
IS : 1498	IS code for Soil Classification	Classification and identification of soils for general engineering purposes
IS : 875 Part 5	IS code for wind load	Code of practice for Wind Load
IS : 875 Part 2	IS code for Live Load	Code of practice for Live Load
IS: 2386 (Part-1 -4) 1963	IS code for aggregate impact value test	Test for Aggregates for concrete
IS:2911 (Part-2) Sec I)-1979	IS code Pile reinforcement design	DESIGN AND CONSTRUCTION OF PILE FOUNDATIONS " CODE OF PRACTICE
IS : 14893	IS code Pile Integrity Test	Non-destructive integrity testing of piles (NDT) - Guidelines [CED 43: Soil and Foundation Engineering]
IS : 456	IS code for formwork removal	Code of practice for plain and reinforced cement concrete
IS : 383	IS code for fine aggregate for concrete	Specification for Coarse and Fine aggregate for use in mass concrete
IS: 2386 (Part-1 -4) 1963	IS code for sieve analysis of coarse aggregate	Test for Aggregates for concrete
IS: 2386 (Part-5) 1963	IS code for soundness of aggregate test	Test for Aggregates for concrete

IS: 2386 (Part-3) 1963	IS code for specific gravity of aggregates	Test for Aggregates for concrete
IS : 15622	IS code for vitrified tile flooring	Pressed ceramic tiles [CED 5: Flooring, Wall Finishing and Roofing]
IS : 13630 Part 2	IS code for Water absorption test for tile	Ceramic Tiles-Methods of test, Sampling and Basis of Acceptance, Part 2: Determination of water absorption (see IS 13630 : Parts 1 to 15) [CED 5: Flooring, Wall Finishing and Roofing]
IS : 13630 Part 8	IS code for chemical resistance test for tile	Methods of test, Sampling and Basis of Acceptance, Part 8: Determination of chemical resistance
IS : 1443	IS code flooring tile laying	Code of practice for laying and finishing of cement concrete flooring tiles [CED 5: Flooring, Wall Finishing and Roofing]
IS : 456	IS code construction Water	Code of practice for plain and reinforced cement concrete
IS : 1239 Part 1	IS code for MS pipe	Code of practice for MS steel tubes
IS : 15658	IS code paver block	Precast concrete blocks for paving - [CED 5: Flooring, Wall Finishing and Roofing]
IS : 383	IS code for M Sand	Specification for Coarse and Fine aggregate for use in mass concrete
IS : 10500	IS code for Drinking Water	Drinking water
IS : 1199	IS code for Flow table Test	Methods of sampling and analysis of concrete
IS : 456	IS code for durability test of concrete	Code of practice for plain and reinforced cement concrete
IS : 1905	IS code for Painting work	Code of Practice for Structural use of Unreinforced Masonry [Building Construction Practices including Painting, Varnishing and Allied Finishing]
IS: 2386 (Part-1 -4) 1963	IS code for Sand replacement test	Test for Aggregates for concrete
IS : 1200	IS code for Painting	Method of Measurements of building and

	Measurement	civil engineering works
IS : 3764	IS code for earthwork excavation & backfilling	Code of safety for excavation work
IS : 10430	IS code for lined Canal design	Code of practice for under drainage of lined canals
IS : 2185 Part - 3	IS code AAC block Masonry	concrete masonry units, Part 3: Autoclaved cellular Aerated concrete blocks [CED 53: Cement Matrix Products]
IS : 1285	IS code for Aluminum Sections	Code for designation of aluminum and its alloys. Dimensions for wrought aluminum and aluminum alloys extruded hollow sections
IS: 2386 (Part-1 -4) 1963	IS code for bulking test for sand	Test for Aggregates for concrete
IS : 1949	IS code for Aluminum Doors & Windows	Specification for Aluminum Windows for Industrial Buildings [CED 11: Doors, Windows and Shutter]
IS : 8147	IS code aluminum sections in Structure	Code of Practice for Use of Aluminum Alloys in Structures
IS: 2386 (Part-1 -4) 1963	IS code for Silt content test for sand	Test for Aggregates for concrete
IS: 1477 (Part-1) 1971	IS code for Sand blasting	Painting of Ferrous metals in buildings (Pretreatment)
IS : 4990	IS code for Shuttering work	Specification for plywood for concrete shuttering work
IS : 456	IS code for De-shuttering period	Code practice of concrete methods
IS : 1200	IS code for shuttering measurement	Method measurement of construction
IS : 1239	IS code for Stainless Steel Pipe	Steel Tubes, Tubular and Other Wrought Steel Fittings, Part 1: Steel Tubes [MTD 19: Steel Tubes, Pipes abd Fittings]
IS : 13826 Part 7	IS code for bitumen extraction Test	Bitumen based felts - Methods of test, Part 7: Determination of binder content [CED 41: Waterproofing and Damp-Proofing]

IS : 5816	IS code for Split tensile test for concrete	Method of Test Splitting Tensile Strength of Concrete [CED 2: Cement and Concrete]
IS : 1608	IS code for Tensile test of Steel	Mechanical testing of metals - Tensile Testing [MTD 3: Mechanical Testing of Metals]
IS : 1172	IS code for Plumbing work	Code of Basic Requirements for Water Supply, Drainage and Sanitation [CED 24: Public Health Engineering.]
IS : 1893 Part 1	IS code for Plumbing work	Criteria for Earthquake Resistant Design of Structures, Part 1: General Provisions and Buildings [CED 39: Earthquake Engineering]
IS : 2751	IS code for welding reinforcement steel	Code of practice for welding of mild steel structures are folded plates
IS : 2879	IS code for Welding Electrodes	Mild steel for metal arc welding electrodes
IS : 814	IS code for Welding Electrodes for manual welding	Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon Manganese Steel
IS : 2131	IS code for Standard Penetration Test	Method for standard penetration test for soils
IS : 399	IS code for classification of Timber	Classification of Commercial Timbers and Their Zonal Distribution
IS : 2380 Part 1	IS code for testing for Timber	Methods of Test for Wood Particle Boards and Boards from Other Lignocellulose Materials [CED 20: Wood and other Lignocellulose products]
IS : 2925	IS code for Safety Helmet	Specification for Industrial Safety Helmets (Bilingual) [CED 22: Fire Fighting]
IS : 2547 Part 1	IS code for Plaster of Paris classification	gypsum building plaster, Part 1: Excluding premixed lightweight plaster [CED 4: Building Limes and Gypsum Products]
IS : 2547 Part 2 Section 1	IS code for Plaster of Paris Testing Method	Methods of Test for Gypsum Plaster, Concrete and Products, Part II:

		Gypsum Products [CED 4: Building Limes and Gypsum Products]
IS : 1199	IS code for Workability of Concrete Test	Code of Practice Method of concrete test
IS : 1124	IS code for Water absorption test of concrete	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones [CED 6: Stones]
IS: 8009 (Part-I) - 1976	IS code for consolidation test of soil	Calculation of settlements of foundations.
IS : 15652	IS code for Rubber Mat	INSULATING MATS FOR ELECTRICAL PURPOSES — SPECIFICATION
IS : 15298 Part 2	IS code for Electrical safety shoes	Personal Protective Equipment, Part 2: Safety Footwear
IS : 3085	IS code for permeability test of concrete	Method of Test for Permeability of Cement Mortar and Concrete
IS : 2720 Part 11	IS code for Tri-axial Compression Test	Methods of test for soils, Part 11: Determination of the shear strength parameters of a specimen tested in unconsolidated undrained triaxial compression without the measurement of pore water pressure
IS : 13311 Part 2	IS code for concrete NDT Test	Method of non-destructive testing of concrete-methods - Rebound hammer
IS : 1742	IS code for Storm Water Drainage	Code of practice for building drainage
IS : 2189	IS code for fire detectors alarm	Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System Code of Practice [CED 22: Fire Fighting]
IS : 2720 Part 3 Section 1	IS code for specific soundness of cement test	Determination of specific gravity, Section 1: Fine grained soils
IS : 456	IS code for Column Design	Code of practice for plain and reinforced concrete
IS : 2720 Part 16	IS code for CBR Test	Methods of test for soils, Part 16: Laboratory determination of CBR [CED

		43: Soil and Foundation Engineering]
IS : 4151	IS code for Safety PPE	Protective Helmets for Motorcycle Riders--Specification
IS : 1199	IS code for Vee Bee Test	Methods of sampling and analysis of concrete
IS : 2720 Part 3 Section 1	IS code for specific gravity of cement test	Determination of specific gravity, Section 1: Fine grained soils
IS : 13311 Part 1	IS code for NDT Test	Method of Non-destructive testing of concrete - Ultrasonic pulse velocity
IS : 2720 Part 8	IS code for compaction Factor Test of Soil	Methods of test for soils, Part 8: Determination of water content-dry density relation using heavy compaction
IS : 2571	IS code for VDF Flooring	Code of practice for laying in-situ cement concrete flooring
IS : 1742	IS code for sewer design	Code of practice for building drainage
IS : 1199	IS code for Slump Cone Test	Methods of sampling and analysis of concrete
IS : 2185 Part - 3	IS code for Solid Block Masonry Work	concrete masonry units, Part 3: Autoclaved cellular Aerated concrete blocks [CED 53: Cement Matrix Products]
IS : 9890	IS code for Ball valve	General Purpose Ball Valves [MED 17: Chemical Engineering Plants and Related Equipment]
IS : 13095	IS code for Butterfly Valve	Butterfly valves for general purposes [MED 17: Chemical Engineering Plants and Related Equipment]
IS : 14846	IS code for Sluice valve	Sluice Valve for Water Works Purposes (50 to 1200 mm Size) - [CED 3: Sanitary Appliances and Water Fittings]
IS : 1742	IS code for Sewer Line design	Code of practice for building drainage
IS : 2720 Part 8	IS code for Soil compaction Test	Methods of test for soils, Part 8: Determination of water content-dry

		density relation using heavy compaction
IS : 456	IS code for expansion joints in concrete	Code of practice for plain and reinforced concrete
IS : 15105	IS code for Sprinkler System	Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems--Code of Practice
IS : 1597 Part 1	IS code for Stone Masonry	Construction of Stone Masonry - Code of Practice, Part 1: Rubble Stone Masonry [CED 13: Building Construction Practices including Painting, Varnishing and Allied Finishing]
IS : 1130	IS code for Kota Stone Masonry work	IS 1130 (1969): marble (blocks, slabs and tiles) [CED 6: Stones]
IS : 5758	IS code for Kerb Stone work	Precast Concrete Kerbs, Channels, Edgings, Quadrants and Gutter Aprons [CED 53: Cement Matrix Products]
IS : 6186	IS code for bentonite	Specification Of Bentonite
IS : 456	IS code for standard deviation of concrete	Code of practice for plain and reinforced concrete
IS : 14536	IS code for submersible pumps	Selection, installation, operation and maintenance of submersible pump set - Code of practice
IS 4031-1996 Part-5	IS code for initial setting time of cement	Methods of physical tests for hydraulic cement - Determination of initial and final setting times
IS : 8990	IS code for Industrial safety	Code of practice for maintenance and care of industrial safety clothing [CHD 8: Occupational Safety, Health and Chemical Hazards]
IS : 9457	IS code for Signages	Safety colours and safety signs - Code of Practice [CHD 8: Occupational Safety, Health and Chemical Hazards]
IS : 456	IS code for construction joints in concrete	Code of practice for plain and reinforced concrete

IS: 7272 (Part 1) 1974	IS code for Labour Output	Labour output constants for building work (north zone)
IS : 2309	IS code for lightning arrestor protection	Code of practice for the protection of buildings and allied structures against lightning [ETD 20: Electrical Installation]
IS : 456	IS code for durability of concrete	Code of practice for plain and reinforced concrete
IS :2629	IS code for Hot Dip galvanizing	Recommended Practice for Hot-Dip Galvanizing of Iron and Steel [MTD 7: Light Metals and their Alloys]
IS : 1500	IS code for brinell hardness test	Method for Brinell Hardness Test for Metallic Materials
IS : 2386 Part 4	IS code for abrasion test	Methods of test for aggregates for concrete
IS : 2720 Part 10	IS code for unconfined compression test	Methods of test for soils, Part 10: Determination of unconfined compressive strength
IS : 15797	IS code for Rain water harvesting	Roof top rainwater harvesting - Guidelines
IS: 732 - 1989	IS code for Cable tray laying	Electrical Wiring installations
IS : 456	IS code for curing of concrete	Code of practice for plain and reinforced concrete
IS : 15785	IS code for Lift	Code of practice for Installation and maintenance of lift without conventional machine rooms
IS : 1757	IS code for charpy impact test	Method for charpy impact test (V notch) for metallic material
IS : 1201 to 1220	IS code for bitumen test	Methods for Testing Tar and Bituminous Materials
IS : 2720 Part 28	IS code for Sand replacement test	Methods of test for soils, Part 28: sand replacement method
IS : 456	IS code for shrinkage of concrete shrinkage of concrete	Code of practice for plain and reinforced concrete

Section - III

1.5 MATERIALS

1.5.1 CEMENT

1.5.1.1 Cement shall be ordinary Portland cement/PPC conforming to IS 269 for all purpose. It shall be received in Paper bags of 50 kg and each batch shall be accompanied with a test certificate of the factory. Also it shall be tested before use to ascertain its strength, setting time, etc. In no case cement which has been stored over 4 weeks, shall not be used unless tested as per the direction of the PMC/ BANK prior to use in the works.

Cement shall be stored in such locations so as to prevent deterioration due to moisture dampness. A dry and waterproof shed shall be best suited for this. Bags shall be stacked on rigid water-proof platforms about 15 to 20 cm clear above the floors and 25 to 35 cm clear or away from the surrounding walls. A maximum high stack of 12 bags is permitted. Stacks shall be so arranged that the first batches are used first, (FIFO) & that they permit easy access for inspection and handling.

1.5.2 COARSE AGGREGATE

1.5.2.1 Coarse aggregate shall be obtained from natural sources such as stone, gravel etc. crushed or uncrushed or a combination thereof from approved quarries. Aggregate shall be hard, strong, dense, durable, clean and free from veins and adherent coating. It shall be free from soft, feeble, thin, elongated or laminated pieces and shall be roughly cubical in shape. It shall consist of coarse material most of which is retained on 4.75 mm IS sieve.

1.5.2.2 Coarse aggregate shall not contain any harmful material such as iron, pyrites, coal, mica shale or similar laminated material neither shall it contain clay, alkali, soft fragments, seashells, organic impurities etc. in such quantities that adversely affects the strength and durability of the concrete. In addition to the above, in reinforced concrete the aggregate shall not contain any material, which might attack the reinforcement. The maximum quantities of deleterious materials in the coarse aggregate when determined in accordance with IS 2386 Part I and Part II "Method of test for aggregates for concrete" shall not exceed the limits laid down in table 1 of Annexure.

1.5.2.3 Aggregate crushing value, impact value, abrasion value and soundness of aggregate shall respectively be in accordance with Para 3.3, 3.4, 3.5 and 3.6 of IS 383.

1.5.2.4 Grading of coarse aggregate shall be in conformity with the requirements laid down in IS 383. See Table 2 and Table 3 of Annexure.

1.5.2.5 Aggregates shall be stored in such a way that it does not get mixed with mud, grass vegetables and other foreign matter. The best way is to have a hard surface platform made out of concrete, bricks or planks. It should be to the approval of the PMC/ BANK.

1.5.2.6 Coarse aggregate shall have a minimum specific gravity of 2.6 (Saturated surface dry basis). Aggregate below this specific gravity shall not be used without the special permission of the PMC/ BANK.

1.5.2.7 Once a specific source of supply of coarse aggregate is approved; the source shall not be changed without the prior approval of the PMC/ BANK.

1.5.3 FINE AGGREGATE

1.5.3.1 Natural sand deposited by stream or glacial agencies as a result of disintegration of rock is the best form of fine aggregate. The fine aggregate shall conform to following standards.

- I. For plain and reinforced concrete: IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
- II. Mortar and grout :IS 2116 Specification for sand for masonry mortars.
- III. For plastering : IS 1542 Specification for sand for plaster (Class A grading)

1.5.3.2 Sometimes it is obtained from crushed stone screening but often contains a high percentage of dust and clay. It tends to be flaky and angular. This type produces harsh concrete and should be avoided.

Sea sand should not be used unless approved by the PMC/ BANK. If approved, the required treatment shall be done at the contractor's cost.

1.5.3.3 Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay. Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength of durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

- i) When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of Annexure.
- ii) Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious materials is within the permissible limits laid down.

1.5.3.4 Grading of fine aggregate shall conform to IS and shall fall within limits of one of the four zones given in table 4 of IS 383 and of Annexure.

1.5.3.5 Damp and moist sand increases the volume and is called bulking. Due allowance is to be made while preparing the mixes based on volume measurements. It shall be determined as per IS 2386 Part III Appendix A. For rough guidance table 5 of Annexure gives the relation between moisture content and percentage of bulking.

1.5.3.6 Storing of aggregate shall be as given in Clause 11.5.2.6.

1.5.4 WATER

Water used for mixing and curing shall be clean, reasonably clear and free from objectionable quantities of silt, oils, alkalize, acids, salts so as not to weaken mortar, or concrete or cause efflorescence or attach the steel in RCC while curing. It shall be free of elements, which significantly affects the hydration reaction or otherwise interferes with hardening of concrete during curing or those elements, which produce objectionable stains or deposits. Potable water is generally satisfactory but is shall be tested prior to use in the works.

Water tested shall be in accordance with IS 3025. Maximum permissible limits of deleterious materials in water as given in IS 456 are reproduced for ready reference in table 6 of Annexure.

Suitability of water shall be ascertained by the compressive strength and initial setting time test as specified under:

- i) Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. Preparation and testing in accordance of IS 516.
- ii) The initial setting time of tests blocks made with proposed cement and water to be used shall not be less than 30 minutes and shall not differ by ± 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water.
- iii) Preparation and testing of block shall be in accordance with IS 4031
- iv) The PH value of water shall not be less than 6 and more than 9.
- v) Water storage tanks shall be such as to prevent any deleterious materials getting mixed with it.
- vi) Water shall be tested and approved in writing by the PMC/ BANK prior to use in the works.

- vii) Sea water in concrete shall not be permitted unless specifically approved in writing by the PMC/ BANK for purpose stated. The PMC/ BANK under unavoidable circumstances may allow mixing or curing of seawater in concrete construction, which are permanently under seawater.

1.5.5 ADMIXTURE

These are substances other than cement, aggregate and water and shall be permitted to be used to modify the properties of concrete for single or a combination of purposes. This shall be used only on the written approval for specific purpose and at the cost of the contractor. Good concrete shall be achieved without the aid of any admixtures.

Admixtures should be free from chlorides and sulphate, which might affect concrete or any other material which may cause problems to the concrete in the due course of time. Also it should have no effect on the reinforcement in case of Reinforced Cement Concrete.

Admixtures generally in use are classified as under:

- a) Accelerators
- b) Retarders
- c) Workability agents
- d) Water -repelling agents
- e) Air-entraining agents
- f) Gas-forming agents.

These are manufactured and sold by various companies under brand names. The contractor proposing to use any of them shall submit to the PMC/ BANK technical literature with its chemical composition, purpose of use and method recommended by the manufacturer and what he proposes to follow at site for strict control.

- i) The contractor's proposal shall accompany the following with his request to use admixture.
- ii) The trade name of the admixture, its source and the manufacturer's recommended method of use.
- iii) Typical dosage rates and the possible detrimental effects of under and over dosage.
- iv) Whether the admixture contains chloride in any free form or any other chemical present as an active ingredient, which is a likely cause of corrosion of reinforcement or deterioration of concrete.
- v) The average expected air content of freshly mixed concrete containing an admixture, which causes air to be entrained when used at the manufacturer's recommended rate of dosage.

1.6 CONCRETE

Concrete is prepared by mixing graded aggregate stone along with cement, in a specified proportion. Mixing shall be done by a mechanical mixer. Manual hand mixing shall be permitted in specific cases with the written permission of the PMC/ BANK on account of small quantity or location or any other reason acceptable.

1.6.1 CEMENT CONCRETE

This shall be classified as plain cement concrete or reinforced cement concrete. Plain cement concrete shall be in leveling course under foundations, floors, copings etc. and shall include form work as part of the work.

Reinforced cement concrete shall be at all locations and comprise of form work, reinforcement and concrete.

Concrete shall be classified by its compressive strength at the 28th day. The concrete grades shall be as designated in table 2 of IS 456 and are given as ready reference in table 7 of Annexure.

- 1.6.1.1 It shall be the responsibility of the contractor to carry out design mixes and approval of the same shall be obtained from the PMC/ BANK at least 35 days in advance from the actual pouring of concrete at site in the permanent works. The basic aim of mix design shall be to find the most economic proportion of cement, aggregates and water which will give the desired strength of concrete, proper workability and durability. Also it is important that the mix should be easily worked with the help of equipment available at site. The operations involved at site are, measurement of materials, their mixing, placing, compacting, finishing required and curing. The design shall be carried out strictly to IS specifications and IS code practice 456, SP 23 and SP 24. Further the contractor should ensure that the minimum cement content per cubic meter of reinforced concrete should not be less than that stipulated in table 23, 24, 25 and 26 of SP 23. For ready reference refer table 8 and 9 of Annexure, but the BOQ shall specify minimum cement content for each item.
- 1.6.1.2 For expected strength of cubes tested on the 28th day the design mix at preliminary test and work site shall be as per table 10 of Annexure. The water cement ratio shall be 0.50 to 0.52. Additional water may be permitted only at the discretion of the Structural Engineer. The slump shall be 25 mm to 35 mm depending upon the location and type of work. Higher slump with use of plasticizers shall be permitted.
- 1.6.1.3 Design mix and trial mixes
- 1.6.1.4.1 As stated above in clause 11.6.1.2 the contractor shall submit, at least 5 weeks in advance, to the PMC/ BANK the mix design that the proposes to use at site. The mix design shall also give basic details (when tested according to IS 1199 and IS 2386 – Part III, 1963) such as.
- a. Slump
 - b. Bleeding
 - c. Compacting factor
 - d. Vee-Bee time
 - e. Cement required for one cubic meter of concrete.
- 1.6.1.4.2 On receipt of this, the PMC/ BANK may immediately order to carry out work site test before the final approval. This shall be done with mixer and materials actually being used at site. This shall give the contractor additional chance to check for himself actual workability and make sure that the mix proposed by him/her will be fully satisfactory with regards to slump, segregation, bleeding, water –cement ratio and workability. 5 cubes shall be taken from each of the 3 batches to test the mix. Cubes shall be cast, stored, cured, transported and tested to IS 516. The test may be carried out at site or laboratory as approved by the PMC/ BANK. Trial mixes shall be approved provided that average strength of 3 consecutive cubes is not less than that specified and that one out of three may give a value less than specified but limited to a maximum of 90% of the specified strength.

In case the trial mix falls below the above criteria, the PMC/ BANK shall order fresh trial mixes

to be made as before, until the desired strength is arrived at.

This design mix and trial mix hold good so long as the materials continue to be of the same quality and from the same sources. For any change, the PMC/ BANK may order fresh design mix and trial mixes to be carried out before the same is used at site.

It is the responsibility of the contractor to prepare and get the cubes tested and to provide all the material, labour, moulds, equipment, casting and curing facility, charges for testing etc.

Further, the contractor shall have to provide and maintain all the equipment and staff at the site throughout to carry out the following tests in a small laboratory or get these tests from approved laboratories without extra cost to the contract.

- i. Slump
- ii. Grading of coarse and fine aggregates.
- iii. Silt content of sand.
- iv. Moisture content of coarse and fine aggregates.
- v. Slump test of concrete.
- vi. Concrete cube test.

The contractor shall maintain full records of all above tests in a register.

The format of records shall be prepared in consultation with the PMC/ BANK and either he or his representative shall have full access to the contractor's laboratory.

The contractor shall include charges for the above work in his rates and no extra whatsoever shall be admissible on this account of designing, testing maintaining laboratory etc.

1.6.2 READY MIX CONCRETE (RMC) will be used for mass concreting work as per the structure design and drawings. However, for small concreting such as individual column, beam, etc., will be cast in situ.

a. CEMENT

- i) The type of cement used for this work shall be ordinary Portland Pozzolana Cement. 100% cement use in project shall be PPC with minimum 30% fly-ash content.
- ii) Cement shall be used in the order in which it is received. Cement in bags in storage for more than 3 months shall be re-tested before use.

b. AGGREGATES: Used for concrete shall be in accordance with the requirements of IS 456.Ref. IS 4926:2003 RMC code of practice Clause 4.4

TESTING: A sample taken once for every 2500 bags shall be tested. Tests shall be carried out for Fineness, initial and final setting time, compressive strength (IS: 4031) and the results approved by the Engineer, before use of the cement in permanent works. Samples shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall

be in accordance with IS: 35555

The Engineer may specify other forms of sampling and tests including chemical analysis (IS: 4032). If in his opinion the cement is of doubtful quality, the costs of such additional tests shall be borne by the contractors.

In addition to above, the cement shall conform to standard specifications of Government of A.P & CG PWD/CPWD

c. MIXERS AND VIBRATORS:

- i) For all structural concrete work, the contractor shall provide platform types of weighing machinery of a capacity not less than 200 kg.
- ii) The contractor shall provide concrete mixers (IS:1791)
- iii) Batch type concrete mixers (IS: -2439)-roller APN mixer and vibrators (IS:2505)
- iv) Concrete vibrators Immersion type (IS:20506)
- v) Screed-board concrete-vibrators (IS:250)
- vi) Screed board concrete vibrators (IS:4656)
- vii) Form-vibrators for concrete supplied by recognized manufacturers.

1.6.3 CONVEYING:

Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods which will prevent segregation and/or loss of ingredients. In case such segregation occurs invade concrete shall be remarked before being placed in final position. It shall be deposited in final position as early as practicable, but always within a period of 30 minutes after mixing. When initial set has taken place in Concrete before it is placed in final position, such concrete shall be rejected and taken away from the site to a distance and disposed off as ordered by the PMC/ BANK.

1.6.4 GRADE OF CONCRETE:

The Concrete is designated as M-15, M-20, M-25, M-30, and M-40 etc. The letter M refers to the Mix and the number represents the characteristic compressive strength in Mpa (Mega Pascal's). Maximum content of cement as per table 5 of IS 456.

TRIAL MIXES:

- a. The Contractor is entirely responsible for the design of Concrete mixes. The design however to be approved by the PMC/ BANK at least 7 weeks before commencing an concreting in the works and which have been tested in an approved laboratory. A clean dry mixer shall be used and the first batch discarded.
- b. The required average strengths of different grades of concrete at 28 days, for which the mixes shall be designed are specified below:

Grade of Concrete	Characteristic strength at 28 days (MPs)	Target Mean Strength at 7th day (MP)	F'cm (Mpa) at 28 days
M15	15	18	24

M20	20	21	29
M25	25	23	24
M30	30	26	39
M35	35	31	44
M40	40	36	49
M45	45	40	54
M50	50	45	60

The mixes are designed to yield mean strengths (F'_{cm}) greater than the corresponding specified characteristic strengths (F'_{ck}) as indicated in above table. The difference between F'_{cm} and is called the current Margin. The value of the current margin has been set at 9 Mpa for all grades of concrete. The concrete mixes shall be designed on the basis of required strength, desired workability, the maximum size of aggregate and also upon the various grades of cements as specified in IS 10262-1982. Accordingly the required cement content shall be ascertained. The Contractor may be allowed to use either approved plasticizers or increased cement content to achieve the required strengths at his own cost.

For each grade a total of 18 cubes shall be made. Of these 18 cubes made, not more than 6 may be made on any day and further of the 6 cubes made in one day, not more than 2 cubes, each representing a different batch of concrete shall be tested at the age of 7 & 28 days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with Indian Standards IS: 516. The test shall be carried out in a laboratory approved by the PMC/ BANK.

- c. If the average strength of the concrete cubes falls below the required strength, fresh preliminary mixes for that grade shall be made as before, until the trial mixes yield cubes of compressive strength at 28 days greater than the required average strength at that age.
- d. Whenever there is a significant change in the quality of any of the ingredients for concrete, the PMC/ BANK may at his discretion, order the carrying out of fresh trial mixes. All costs for trial mixes and tests shall be to the Contractor's account and held to be included in the contract rates,
- e. Before commencing the work, the contractor shall submit to the PMC/ BANK for approval full details of all preliminary trial mixes and tests.
- f. When the proportions of a concrete mix have been approved by the PMC/ BANK, the Contractor shall not vary the quality or source of the material or the mix without written approval of the PMC/ BANK.

1.6.5. CONCRETE CUBE TEST:

Quality of hardened concrete will be certified by the following procedures

- a. The PMC/ Bank or his representative shall select random batches of concrete for examination without warning the Contractor and sampling will generally be done at point of discharge from the mixer.
- b. Rom the batches thus selected, 6 concrete cubes shall be made from any single batch, of these. 6 cubes may be made from any single batch. Of these 6 cubes thus made, 3 cubes (each cube representing Concrete of different batches) shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days.
- c. All cubes shall be made, cured, stored, transported and tested in accordance with Indian standards. The tests shall be carried out in a laboratory approved by the PMC/ Bank.

- d. At least 6 cubes shall be made on each days concreting until 60 cubes have been made for each grade of concrete. This is in initial period.
- e. After the initial period, subject to the acceptance of the PMC/ Bank, the frequency at which the cubes shall be made may be reduced as follows: 1 set of 6 cubes, on each day's Concreting consisting of:
 - i) 1 set for every 10 Cum. or part thereof of concrete for critical structural elements like columns, large cantilevers, plus:
 - ii) 1 set for every 40 Cum. or part thereof for all other elements. If concrete is latched at more than one point simultaneously, the above frequency of making cubes shall be followed at each point of batching.
 - iii) Of the cubes if each set shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days from the day of casting the cubes.

1.6.6 ACCEPTABILITY CRITERIA:

The strength requirement of any particular grade of concrete will be considered satisfactory if the 28 days compressive strengths of individual sets (each set consists of 3 cubes) and of individual cubes satisfy the following requirements:

FOR THE FIRST FIVE SETS:

- a. The average strength determined from any group of three consecutive test cubes exceeds the specified characteristic strength (F'_{ck}) by not less than 0.8.
- b. Only one individual cube test result in any set may fall below the specified characteristic strength provided that this value is not less than 95% of the specified characteristic strength.
- c. Provided that the average strength of any fifteen consecutive cubes exceeds the specified characteristic cube strength by at least 0.9 times the current margin. All the subsequent test results may be considered acceptable if:
 - i) The average strength as determined from any group of three consecutive test cubes exceeds the specified characteristic strength (F'_{ck}) by not less than 0.6 times the current margin.
 - ii) Only one individual cube test result in any set may fall below the specified characteristic strength provided this value is not less than 90 % of the specified characteristic strength.
- d. Whenever a mix is redesigned due to a change in the quality of Aggregate or of cement or for any other reason, it shall be considered a new mix and initially be subject to the acceptability criteria as stated above.. The above specification is based on an assumed standard deviation of 5.5 Mps, and a probability of concrete strengths failing below the desired minimum strength of 1 to 20. In case quality control is very good at site and the cube test results consistently show a standard deviation better than the standard deviation assumed here, the Engineer may in his discretion reduce the required target strength F'_{cm} for any particular grade of concrete, and in the current margin.
- e. If the concrete produced at site does not satisfy the above strength requirements, the PMC/ Bank will reserve the right to require the Contractor to improve the methods of batching, the quality of the ingredients and redesign the mix with increased cement content if necessary. The Contractor shall not be claimed any extra cost for the extra

cement used for the modifications stipulated by the PMC/ Bank for fulfilling the strength requirements specified.

- f. It is the complete responsibility of the Contractor to design the concrete mixes by approved standard methods and to produce the required concrete conforming to specifications and the strength requirements approved by the PMC/ Bank. It is expected that the contractor will have competent staff to carry out this work.
- g. As frequently as the PMC/ BANK may require, testing shall be carried out in the field for:
 - i) Moisture content of sand
 - ii) Moisture content of Aggregates
 - iii) Silt content of sand.

1.6.7 VOLUME, BATCHING WITH WEIGHT CONTROL:

Where volume batching with weight control is specified by the Architect /PMC all measurements of coarse aggregates and water shall be by volume and of cement by the bag, controlled by regular periodic weightings. In order to ensure correct proportioning the following precautions shall be taken.

- a. The contractor shall maintain at site suitable number of platform balances similar to the balance used for weighing luggage at railway platforms, capable of weighing upto 200 kg. To the nearest 100 grams; the balance shall be used for weighing cement bags and occasional boxes of sand and coarse aggregate as specified below.
- b. The Contractor shall provide the mixer operator with standard measures for measuring the water to be used in the mix.
- c. The quantity of water to be added to the mix shall be approved by the PMC/ BANK or his representative and may be adjusted by him/her as frequently as necessary in order to allow for the moisture content of the sand or coarse aggregate and workability desired. On no account shall the Contractor allow more water to be added to the mix. Concrete containing water in excess of that specified shall be rejected and not allowed for use in the works.
- d. Sand and coarse aggregates shall be measured by volume. The size of measuring boxes or the depth to which they are filled or both shall be adjusted to obtain the correct weight of each material specified by the Engineer for that mix.
- e. Every fifth or tenth measuring box of sand or of coarse aggregate shall be weighed on the balance to ensure that filling of boxes is being uniformly done. Adjustments shall be made from time to time in the amount of each box filled to take into account variations in moisture content and consequent bulking of sand. More frequent weighing of boxes, particularly of sand if found to vary considerably in moisture content and building may be required by the PMC/ BANK and shall be done by the Contractor without additional cost.

1.6.7.1. WEIGH BATCHING:

All structural concrete shall be weigh batched. All concrete ingredients except shall be batched by weight using a weigh batcher of an approved make (15:2722 Portable swing weigh batchers for concrete). Batching shall be to an accuracy of not less than 1/2 kg and the batcher shall be test for accuracy of calibration before commencement of the works and at least once a week thereafter or more frequently if so required by the PMC/ BANK. For calibration & weighing equipment refer to Annexure of IS 4926: 2003 RMC

code of practice.

Water shall be batched by weight or by volume measures as approved by the PMC/ BANK. The method of batching shall be such as will ensure in accuracy to 0.5 litres or better.

1.6.7.2. PLACING TEMPERATURES:

During extreme hot or cold weather, the concreting shall be done as per procedures set out in IS: 7861, Parts I & II. Fine and coarse aggregates for concreting shall be kept shaded and the concrete aggregates sprinkled with water for a sufficient time before concreting in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the PMC/ BANK may in his discretion specify the use of ice must either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case, the Contractor shall not be paid any extra on account of ice and additional labour involved in weighing and mixing etc.

1.6.7.3. TRANSPORTING, PLACING, COMPACTING AND CURING:

- a. Transporting, placing, compacting and curing of concrete shall be in accordance with IS: 456. For workability refer to clause 6.2 of IS 4926:2003 RMC code of practice.
- b. All rubbish etc. inside the shuttering and curing of concrete shall be washed out immediately prior to placing of concrete. A layer is placed and separate batches shall follow each other so closely that the succeeding layer shall immediately below have taken initial set. The method of segregation, concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer or his representative. It should be held in position until air bubbles cease to come to the surface and then slowly withdrawn so that the concrete can flow into the space previously occupied by the vibrator. The vibrator shall not be dragged through the concrete nor used to help heaps of concrete to spread out. It may be used vertically, horizontally or at an angle depending on the nature of the work.
- c. To secure even and dense surfaces free from aggregate pocket, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.
- d. A sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.
- e. Form vibrators when used shall be clamped to the sides of formwork and shall not be fixed more than 450 mm. above the base of the new formwork and concrete shall be filled not higher than 230 mm. above the vibrator. The formwork must be made serially strong and watertight where this type of vibrator is used. Care must be taken to guard against over vibration especially where the workability or the concrete mix is high since this will encourage segregation of the concrete. All concrete shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground and with water draining there from during placing and for a period of seven days or as otherwise instructed thereafter. Approved means shall be taken to protect immature concrete from damage by debris,

excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth or other materials and other influences that may impair the strength and durability of the concrete.

1.7. CONCRETE AT SITE

- a. Weight batching shall be preferred at site but the PMC/ BANK may permit designed mix to be converted to volumetric if requested by the contractor on specific grounds. The contractor shall provide required boxes to measure the ingredients of concrete.
- b. The contractor shall provide concrete batch mixes, vibrators, weigh batches conforming to relevant IS specification. The capacity and number of mixers and vibrators required at site from time to time shall be to the approval of the PMC/ BANK. No equipment from site shall be removed without the prior written approval of the PMC/ BANK. The contractor shall also maintain a platform weighing scale of capacity 300 kg with fraction upto 100 Gms at the site.

As directed by the PMC/ BANK, a weekly or periodic calibration of all machines shall be done and records of these calibrations shall be maintained in a register. Regular maintenance of machinery shall also be carried out on a weekly basis or as directed by the manufacturer of machines.

- c. The mixer shall be run for a minimum period of 2 minutes after all materials are loaded in full quantity. The concrete produced shall be uniform in colour and consistency.
- d. The placing temperature of concrete shall not be more than 34o C. If it is more, the PMC/ Bank may order addition of ice or chilled water to the concrete. Also the contractor shall take the following precautions:
- e. Mixers and weight batches shall be painted with white colour
- f. Aggregate storing bins shall not be exposed to the Sun.
- g. Water shall be sprinkled on aggregates well before concreting to keep the temperature low.

1.7.1. SHRINKAGE CRACKS

Concreting shall be avoided in very warm weather, if necessary; it shall be covered with damped Hessian within 2 hours of placing of concrete. To achieve good results the concrete shall be immediately covered with a plastic sheet and not allowed any direct wind contact. This shall eliminate shrinkage cracks.

1.7.2. LAYING OF CONCRETE

Concreting shall commence only after form work is approved, reinforcement is recorded and permission to proceed with concreting has been approved in writing from the PMC/ BANK.

Formwork should be clean, free from sawdust, pieces of wood or any other foreign material. It should have been treated by form releasing agent prior to the laying of reinforcement and concrete.

Concrete shall be as gently deposited as is practically possible. In its final position to avoid re-handling and shall be so deposited that segregation of aggregates does not occur. In case of deep trenches and footing, it may be done with the help of a chute. Columns and walls shall be so adjusted in form work so that maximum depth is 1.5 meter unless consented to by the PMC/ BANK. Concrete from wheel barrows shall not be

dumped away from the face concrete already in place. It shall be dumped into the face of concrete already in place.

Concrete onto a sloping surface shall be discharged by providing a chute with a baffle and a drop at its end so that the concrete remains on the slope.

Columns and walls shall be concreted in the operation to their full height to avoid any horizontal construction joints as far as possible. All slabs, beams, wooden planks and cat-walk shall be provided clear of reinforcement.

Concrete shall be placed in position within 30 minutes from the time it is produced.

Concrete shall be laid during normal working hours. Concreting at night or on holidays shall be permitted only on the written approval of the PMC/ BANK.

1.7.3. COMPACTION OF CONCRETE

Concrete shall be thoroughly compacted, as depositing shall proceed by means of suitable vibrators. The vibrators shall maintain the entire concrete under treatment in an adequate state of agitation and shall continue during the whole period occupied by placing of concrete. Care shall be taken not to over- vibrate the concrete. While withdrawing needles no holes should be visible in concreting. Compacting shall be completed before the initial setting time. Concrete already set shall not be disturbed by successive vibrations.

It shall be ensured that the needle vibrators are not applied on reinforcement, which may destroy the bond between concrete and reinforcement. When electric vibrators are in use, the standby petrol vibrator must always be available at the concreting point.

1.7.4 CONSTRUCTION JOINTS

In large pours, it is practically not possible to carry on concreting continuously. Hence construction joints shall be provided. Location of construction joint shall be submitted by the contractor for approval of the PMC/ BANK. Such joints shall be kept to a minimum. The joints shall be at places where shear forces nil or minimum and these shall be straight and at right angles to the direction of the main reinforcement.

Stop ends provided shall be with necessary slots for reinforcement bars to pass freely without bending or any other obstruction. Also a trapezoidal fillet nailed on stop board shall be provided to form a regular keyed joint. Joints shall be straight and truly vertical or horizontal.

Before commencement of concrete, adjacent concrete stopper and surfaces shall be chipped and roughened to expose aggregate, then wire brushed and cleaned. The concrete surface shall be sprayed with water for 24 hours before casting and kept wet until casting.

True horizontal joints shall also be provided with a keyed joint by inserting planed greased timber. It shall be treated as above prior to the start of fresh concreting.

For vertical joints neat cement slurry shall be applied on the surface just before concreting. For horizontal joints, the surface shall be covered with a layer of mortar about 10 to 15 mm thick composed of cement and sand in the same ratio as the cement and sand in the concrete mix. This layer of cement slurry shall be freshly mixed and applied just before concreting.

1.7.5 EXPANSION JOINTS

Expansion joints shall be formed and located as detailed in the drawing.

1.7.6 CURING

Curing of concrete is most important. There shall be no compromise on this activity and it is for the contractor to arrange for everything necessary to make sure that the concrete is cured to the complete satisfaction of the PMC/ BANK. As said above in Clause 11.7.3, after concrete has begun to harden i.e. about 1 to 2 hours after laying. It shall be protected from quick drying with moist or damped Hessian cloth or any other material approved by the PMC/ BANK. After 24 hours of laying of the concrete, the surface shall be cured by flooding with water or covering with damp Hessian cloth for a period of 7 days to keep it moist. For the next 7 days the surface shall be kept wet all the time by sprinkling water continuously.

For membrane curing, details as listed in 12.5 of SP 24 shall be followed.

1.7.7 FINISHING

Concrete shall be finished keeping in mind the next operation to be carried out over the surface. For guidance the following points shall be noted but the PMC/ BANK shall be consulted prior to start of concreting and his decision in this regard shall be final.

- Roof slab shall be troweled even and smooth with a wooden float.
- The surface that will receive plaster shall be roughened immediately.
- Surfaces that will be in contact with any masonry work shall be roughened immediately.
- The surface that will receive mosaic floor or IPS or any other type of tiled work shall be roughened while it is green. Every care shall be taken not to disturb the freshly laid concrete.

1.7.8 INSPECTION AND CORRECTIVE MEASURES

On removal of form work, the surface shall be examined by the PMC/ BANK. Till such time, no remedial measures shall be carried out by the contractor. All patching, rectification or chipping shall be done only on the PMC/ BANK's instructions. In case of any violation of this rule, the concrete poured stands rejected. The decision of the PMC/ BANK in this regard shall be final and binding on all parties. Sagged, bulged, patched, honeycombed work shall stand to be rejected for surface that are exposed, or required fair face finish or decorative textured finish. The PMC/ Bank may permit any work found structurally safe and areas of unexposed faces, for repairing. As directed by the PMC/ BANK these works shall be retained and the cost of repair shall be at the contractor's account.

Cracks observed shall be brought to the notice of the PMC/ BANK who shall examine them. It shall be kept under observation and a record shall be maintained for a period of 45 days. It shall be shown to the Structural Engineer and the following procedure shall be followed:

- 1.7.8.1 Cracks not developing further and in the opinion of Structural Engineer not detrimental to the strength of the construction shall be grouted with non shrinking cement slurry or as directed by the PMC/ BANK.
- 1.7.8.2 Cracks developing further and in the opinion of the Structural Engineer, detrimental to the strength of construction, shall be tested as per the relevant Indian Standard.
- 1.7.8.3 Based on result of the test, the PMC/ BANK in consultation with the structural engineer shall

order remedial measures or order the contractor to dismantle construction, cart away the debris, replace the construction and carry out all the consequential works thereto.

1.7.8.4 Cost of the above shall be borne by the contractor if the failure was on his part. In case it is due to design faults, it shall be borne by the employer.

1.7.8.5 The decision of the PMC/ BANK in this matter shall be final and binding on all parties. This decision shall not be open for arbitration.

1.7.9 QUANTUM OF CUBES AND TESTING

The minimum frequency of cube casting shall be as follows. Each sample shall consist of 6 cubes. As per relevant IS code:

Concrete quantity

Number of Samples Upto 5 Cu.m in a day	1
5 cu.m.to 15 cu.m.	2
15 cu.m.to 30 cu.m.	3
30 cu.m.to 50 cu.m.	4
More than 50 cu.m.	4 + one additional cube per each 50 cu m. or

part thereof. Three cubes shall be tested on the 7th day and other three cubes on the 28th day.

1.7.10 ACCEPTANCE OF WORK

It shall be as given in IS 456, SP 23 and SP 24. The guidance brief is as under Part or element of work shall be deemed to be accepted, provided the results of the 28th day cube testing conform to the stated as under

- a) The average of the three consecutive cube's strength shall not be less than the specified strength.
- b) No individual cube strength shall be less than 90% of the specified strength.
- c) If the individual cube strength exhibits more than 33% of the specified strength, such a cube shall be classified as freak and the criteria in (a) and (b) shall be applied to the remaining two cubes and their acceptability determined.
- d) If the concrete tests fail to meet the acceptance criteria of the minimum strength required for respective grades of concrete, the PMC/ BANK may take one of the following decisions:
 - i. Instruct the contractor to carry out such additional tests (e.g. core tests, load tests etc) and / or remedial measures to ensure the soundness of the structure at the contractor's expense.
 - ii. Any decision to accept the work shall be entirely at the discretion of the engineer who may a reduction in the rate of the appropriate item.
 - iii. The work will be rejected and any consequential action as needed shall be taken at the contractor's expense including cutting out and replacing a part or whole of the work.

CONCRETING UNDER SPECIAL CONDITIONS**WORK IN EXTREME WEATHER CONDITIONS**

During hot or cold weather the concreting should be done as per the procedure set out in IS 7861 Part I or IS 7861 Part II or as directed by the PMC/ BANK.

UNDERWATER CONCRETING

The procedure set out under 13.2 of IS 456 shall be followed or as directed by the PMC/ Bank.

CONCRETING IN SEAWATER

The procedure set out under 13.3 of IS 456 shall be followed or as directed by the PMC/ Bank.

CONCRETING IN AGGRESSIVE SOILS AND WATER

Guidelines laid down in 13.4 of IS 456 shall be followed together with the instruction of the PMC/ Bank.

MEASUREMENTS

All works shall be measured in the decimal system.

- i) Dimensions shall be measured to the nearest 0.01 metre except for thickness of slab which shall be measured to the nearest 0.005 metre.
- ii) Areas shall be worked out to the nearest 0.01 sq. m.
- iii) Cubic contents shall be worked out to the nearest 0.01 cu. m.

All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.

Cement concrete work shall be classified as under:

- | | |
|----------------------------|--------------------------|
| i. Concrete cast-in-situ | Plain and reinforced |
| ii. Precast concrete | Plain and reinforced |
| iii. Pre stressed concrete | Cast-in-situ or pre-cast |

- c. All concrete, except as hereinafter provided, shall be measured in cubic meters.
- d. The price of concrete shall include ingredient material, mixing, transporting, hoisting to any height and lowering to any depth, pouring or laying, consolidating, leaving pockets, holes and protecting them till the next operation or completion of work, hacking the surface to provide key for further work including cleaning, wetting surface etc. and preparing construction joints as described in Clause 11.7.4 of this section.
- e. Concrete processed in a special manner for any specific purpose, such as cooled, heated, water- proofed, acid-proofed, heat-resistant shall be measured separately.
- f. Admixtures shall be used if necessary at the request of the contractor for workability and the price for that shall deemed to be included in the contractor's quoted price o concrete.
- g. No reductions shall be made for :
 - i) Ends of dissimilar materials (for example beams, posts, girders, purlins, corbels and steps) upto 500 sq. cm in section.
 - ii) Opening upto 0.1 Sq.mt.

- iii) Volume occupied by reinforcement.
- iv) Volume occupied by drainage, water pipes, conduits, etc. not exceeding 100 sq.cm in cross sectional area.
- v) Small voids each not exceeding 40 Sq.mt. in section.
- vi) Small moulds, drip moulds, chamfers, splays, rounded or covered angles, beads,
- vii) Grooves and rebates upto 10 cm in depth and width.
- h. Expansion joints shall be measured in running metre or sq. m. as the case may be. Price shall include required shuttering, special treatment if any, filler and finishing material as detailed in drawing or the BOQ.
- i. Water proofing of concrete shall be measured separately as an extra over ordinary concrete stating the quantity of water proofing material inliers or kilograms.
- j. Surface treatment shall be measured in square metres stating number of coats and proportioning of water proofing liquid to water.
- k. Cement grouting shall be measured in square metres and the mix specified.
- l. Grouting of holding-down bolts and providing temporary boxing or wedges to form holes shall be enumerated. The mix shall be specified. The price shall include required shuttering, grouting etc.
- m. To keep surface dry while concreting, dewatering due to rains and seepage shall be included in the price of concrete.

Plum Concrete:

Providing and laying plum concrete 1:2:4 with 40% boulders with necessary compaction, vibration, formwork, scaffolding & curing etc. at all levels complete (cement content not less than 185 per Cum and boulder of uniform avg. size 150mm)

1.9. MORTARS

- 1.9.1. Mortars shall be prepared by mixing fine graded aggregate with cement, in the proportion specified for respective items of work as detailed in the BOQ. Mixing of mortars shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the PMC/ Bank. Mortars shall be specified by proportion only and not by strength, volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 Cu.mt. Boxes shall be of size of 40 x 35 x 25 cm. These shall be marked as mortar mixing boxes by red pain and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.
- 1.9.2. Sand for plaster, masonry, PCC, RCC work at site should be used from Palar (River Sand). However the sand quality must be got approved from PMC/ BANK for RMC purpose.

1.10. BRICK WORK

1.10.1. MATERIAL

- a) **Sand for Masonry mortars:** Unless otherwise indicated, sand for masonry mortars shall consist of natural sand (generally termed as coarse sand) crushed stone sand or crushed sand or a combination of any of these conforming to IS 2116-1965 specifications for sand for masonry mortars. Sand shall be hard durable, clean and free from adherent coatings and impurities such as iron particles, alkalis, salts, coal, mica

shale or similar laminated or other materials exceeding the specified limit. Grading of sand shall be as under

IS Sieve	Percentage passing by weight	
	Unreinforced masonry	Reinforced masonry
4.75 mm	100	100
2.36 mm	90-100	90-100
1.18 mm	70-100	70-100
600micron	40-100	40-100
300 micron	5-70	5-70
150 micron	0.75	0-10

- b) The maximum quantities of clay, fine silt and fine dust in sand shall not be more than 4%. Organic impurities shall be below that obtained by comparison with the standard solution specified in 6-2-2 of IS-2386 (Part II 1983). The coarse / fine sand shall be from approved sources.
- c) Common Burnt clay building bricks (hereinafter termed as bricks shall conform to the requirements laid down in IS-1077-1976 for common burnt clay building bricks. (Average compressive strength not less than 35 Kg/sq.cm.), sub Class-A as per parameters given in the IS regarding edges, dimensions etc. The overall dimensions shall however be as per local practice of moulds. Water absorption after immersion in cold water for 24 hours shall not exceed 20% and grading for efflorescence shall be less than moderate. Bricks shall be free from cracks, flaws and nodules of free lime. Dimension shall be all within tolerance. Under / over burnt bricks and warped bricks shall be totally rejected.
- d) Test check on random samples from each lot of bricks brought at site shall be carried out for compressive strength and water absorption test. Results of these tests duly signed and dated by Contractor; Architect and Project Manager shall be recorded in a separate register which shall be kept with the Project Manager.

1.10.2. Workmanship – Masonry Mortars

a) Preparation of cement mortars:

Mortars shall be of mix as indicated. The mixing specified is by volume. Mixing shall be done in a mechanical mixer. The mortar shall be mixed for at least three minutes after adding of water. Cement mortar shall be freshly mixed for immediate use. Any mortar which has commenced to set shall be discarded and removed from the site.

- b) **Bond:** All brick works shall be built in English bond, unless otherwise indicated. Half brick walls shall be built in stretcher bond. Header bond shall be used for walls curved on plan for better alignment, header bond shall also be used in foundation, and stretchers may be used when the thickness of wall renders use of header impracticable. Where the thickness of footings is uniform or a number of courses, the top course of the footings shall be of headers. For load bearing walls brick courses at DPC level and at all slab levels below the bearings of slab shall be as bricks on edges.

Half or cut brick shall not be used except where it is necessary to complete the bond. Overlap in stretcher bond is usually half brick and is obtained by commencing each alternate course with a half brick. The overlap in header bond which is equally half the width of the brick is obtained by introducing a three quarter brick in each alternate course at quoins. In general, the cross joints in any course of brick work shall not be nearer than

a quarter of brick length from those in the course below or above it.

- c) **Curing:** The bricks shall be adequately wet before use and brick work shall be constantly kept wet for at least seven days.

1.10.3. Half brick walls:

- a) The bricks shall be laid in stretcher bond in cement and sand mortar 1:4 (1 cement: 4 coarse sand) or as indicated. The reinforcement shall be 2 Nos. MS round bars or as indicated and as described in section VII steel and iron work. The diameters of bars shall be 6 mm. The first layer of reinforcement shall be used at second course and then at every third course of brick work. The bars shall be properly anchored (minimum 150 mm) at their ends where the portions end or where these walls join with other walls. The inlaid steel reinforcement shall be completely embedded in mortar. Overlap in reinforcement if any, shall not be less than 30 cm. The cover, i.e. the mortar interposed between the reinforcement bars and brick shall not be less than 6 mm. The mortar covering in the direction of joints shall be not less than 15 mm.
- b) 43 Grade/Blended cement may be used for brick masonry and plaster as directed by PMC/ Bank.

1.11. SOLID BLOCK MASONARY

The blocks of concrete shall be of approved mix to satisfy the crushing strength and water absorption test as per IS: 2185 Part / 1979

- i) Crushing strength not less than 50kg/sq cm.
- ii) Water absorption shall not be more than 10%. The finish of blocks shall be fairly good with sharp edges. The mode of measurement shall be as per IS: 2195-Part/1979.
- iii) Size of concrete block shall be 140mmx190mmx390mm for 390mm thick masonry and 90mmx140mmx390mm for 90mm thick masonry.

SECTION – IV**1.12. REINFORCEMENT AND FORM WORK****1.12.1. REINFORCEMENT**

Reinforcement bars used in construction shall be mild steel or medium tensile round bars and high strength deformed bars.

1.12.1.1. M.S. Plain

- a) Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part-I. Steel received shall conform to the following IS with regards to manufacturing and chemical composition.

i) M.S. bar Grade I Steel designation Fe 410-S of IS 226

ii) M.S. bar Grade II Steel designation Fe 410-O of IS 1977 Medium Tensile Steel designation Fe 540 W-HT IS 961 Steel bars

- b) National sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS 1608, read in conjunction with IS 226. For ready reference of minimum requirements, properties are tabulated in table 11 of the Annexure.

1.12.1.2. Tor Steel

- a) High strength deformed bars for use as reinforced in concrete shall be of grade Fe 415, Fe 500 and Fe 550 conforming to IS 1786.
- b) Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228. Permissible limits shall be as shown in table 12 of the Annexure.
- c) Welding of cold work steel bars in reinforcement shall be permitted as per IS 9417. (Recommendation for welding cold worked steel bars for RCC)
- d) Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerance specified therein.

e) Physical properties

- i. It shall satisfy IS 1599 test for bend and re-bend test in conjunction with IS 226.
- ii. Bond requirements shall be deemed to have been satisfied if it meets clause 4.0 of IS 1786.
- iii. Tensile, proof stress and percent elongation shall be as per table 3 of IS 1786 and reproduced as table 13 of Annexure for ready reference.

1.12.1.3. Quality of Material

- a) Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387.
- b) In case bars are without ISI certification mark, the manufacturer shall give a certificate stating process of manufacturer, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the batch production / cast to which it applied. Corresponding number or identification mark should be found on the material.
- c) All reinforcement material shall be free from loose mill scale, excessive rust, loose rust, pitting, oil, grease, paint, mud or any foreign deleterious material present on the

surface. Cleaning shall be done to the satisfaction of the PMC/ BANK.

- d) Each batch brought at site shall be tested prior to use for respective specification / Physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. All rejected material shall be removed from site by the contractor within 3 days of rejection. If the same is not done, the PMC/ BANK shall impose a penalty of Rs. 500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.
- e) Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by tarpaulins or plastic to avoid corrosion and other contamination. It is advised to follow storage methods as described in IS 4082.

1.12.1.4. Miscellaneous

- a) Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Specially PVC made cover spacers shall be used in the Works. Concrete cover spaces may be permitted by the PMC/ BANK. Such concrete spaces shall be cast from concrete and not cement mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.
- b) Binding wire shall be 18 gauge annealed wire conforming to IS 280. Binding shall be done as per direction of structural consultant with double wire. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement.
- c) Deformed bars for concrete reinforcement and rolled mild steel and medium tensile steel conforming to IS 1139 shall be allowed in construction provided they are approved by the PMC/ BANK.
- d) Weight of reinforcement per meter shall be as follows:

1	6 mm	0.222 kg/Rmt
2	8 mm	0.395 kg/Rmt
3	10 mm	0.617 kg/Rmt
4	12 mm	0.888 kg/Rmt
5	16 mm	1.578 kg/Rmt
6	18 mm	1.998 kg/Rmt
7	20 mm	2.467 kg/Rmt
8	22 mm	2.984 kg/Rmt
9	25 mm	3.853 kg/Rmt
10	28 mm	4.834 kg/Rmt
11	32 mm	6.313 kg/Rmt
12	36 mm	7.990 kg/Rmt
13	40 mm	9.865 kg/Rmt

1.12.1.5. Fabrication of reinforcement

- a) Reinforcement shall be fabricated as per the drawing. Bending shall be done mechanically with use of machine or if approved with hand but to the correct radius, with proper tools and platform and shall conform to IS 2502. Bending of material shall be cold bending only. Material shall be inspected for visible defects such as cracks, brittle, excessive rust, loose mill scale etc. Cracked ends of bars shall not be used in Works. Also the bars should be free from any deleterious material and hence the best practice shall be to hose down reinforcement just prior to concreting. It is important that bending, straightening, cutting etc. shall be carried out in a manner not injurious to the material and the safety of the persons working should be ensured.
- b) Anchoring of bars and stirrup shall be provided exactly as detailed in the structural drawing or as directed by the PMC/ BANK.

1.12.2.5.1. Lapping of bar:

Laps shall be strictly as per the drawing or as directed by the Structural Engineer for general guidance, the following principles shall be followed as given in IS 456.

- a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.
- b) Not more than half of the total bars shall be spliced at a section.
- c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and / or using spirals or closely spaced stirrups around the length of the splice.
- d) Lap splices shall not be used for bars larger than 36 mm diameter, for larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.
- e) Lap length including anchorage value of hooks in flexural tension shall be LD (as defined in 25.2.1 of IS 456) or 30 dia whichever is greater and for direct tension 2 LD or 30 dia whichever is greater. The straight length of lap shall not be less than 15 dia or 20 cm. Where LD is the development length as described in 25.2.1 of IS 456.
- f) When splicing of welded wire fabric is to be carried out, lap splices or wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.
- g) The lap length in compression shall be equal to the development length in compression, calculated as described in 25.2.1 of IS 456 or as specified in drawing but not less than 24 dia.

1.12.2.5.2. Spacing of bars

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the PMC/ BANK.

- a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following.
- b) The diameter of the bars, if the diameters are equal.
- c) The diameter or larger bar, if the diameters are unequal and 5mm more than the

nominal maximum size of coarse aggregate (by using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome)

- d) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-third of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.
- e) Where there are two or more rows, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm two third the nominal maximum size of the aggregate or the maximum size of bar, whichever is more.

1.12.2.5.3. Cover to reinforcement

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the PMC/ BANK. The following guidelines are to be observed in the absence of the above.

- a) At each end of the reinforcing bar, not less than 25 mm, nor less than twice the diameter of such bar.
- b) For a longitudinal bar in a column, not less than 40 mm, nor less than the diameter of such bar. In case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.
- c) For longitudinal reinforcing bar in beam, not less than 25 mm, nor less than the diameter of such bar.
- d) For tensile, compressive, shear or other reinforcement, in slab not less than 15 mm, nor less than the diameter of such bar and
- e) For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.
- f) Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals; saline atmosphere etc. and the cover shall be 50 mm or more as directed by the PMC/ Bank. For concrete members totally immersed in seawater, the cover shall be 40 mm more than specified above (a) to (f). This shall be 50 mm more for periodical immersion in sea water.
- g) Concrete cover should not exceed 75 mm in any case. Cover to reinforcement shall be as specified in the drawing or as directed by the PMC/ BANK. Details given in sub Para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

1.12.2.5.4. Fixing in position

Correctly cut and bent bars shall be accurately placed in position as detailed in the drawing. Unless otherwise specified by the PMC/ BANK, reinforcement shall be positioned within the tolerance as under:

- a) for effective depth 200 mm or less ± 10 mm
- b) for effective depth more than 200 mm ± 15 mm

But in no case shall the cover be reduced by more than 5 mm of that specified.

There shall be no compromise on cover for foundation work. Reinforcing bars shall be held in position during the placing of concrete by use of PVC or concrete cover blocks (made of equal / of higher grade strength of well cured concrete in use) steel

chair spacers, steel hangers, supporting wires, etc. and secured by tying with an annealed binding wire of 16 gauge as approved by the PMC/ Bank .

Layer of bars shall be separated by precast concrete spacer blocks or spacer bars. Reinforcement shall be in correct position prior to start of concreting. No reinforcing bar shall be placed on freshly laid concrete for adjusting bar spacing. Care shall be taken to maintain reinforcement in position and keep it clean, throughout the period till it is embedded in the concrete. For maintaining cover, pieces of broken stone or brick or wooden blocks shall not be used at any stage. Binding wire used shall conform to IS 280.

1.12.2.5.4.1. Welded joints or mechanical connections

- a) Welded joints or mechanical connections in reinforcement may be used but, in all cases, or important connections, tests shall be made to prove that the joints are of the full strength of the connected bars. Welding of reinforcement shall be done in accordance with IS recommendation.
- b) Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time is the radius of the bend less than 4 bar diameters in case of plain mild steel or 6 bar diameters for deformed bars. Care shall be taken when bending back bars to ensure that the concrete around is not damaged / disturbed.

1.12.2.5.5. Welding rods used shall conform to IS 814: covered electrodes for metal arc welding of structural steel. Work shall be carried out by a competent welder. Samples from Work site shall be taken at regular intervals and tested. Frequency and number of samples shall be as directed by the PMC/ Bank.

1.12.2.5.6. Measurements

Reinforcement shall be measured as follows:

- a) Lengths of different diameters of bars actually used included authorized overlaps shall be measured nearest to a centimetre and their weight calculated as given in table 11.12.2.4. shall be used.
- b) Chairs and spacer bars shall not be measured and paid. The contractor shall account for all these in his quoted price.
- c) In case of welded coupled joints, measurement for payment shall be equivalent to the length of overlap, as per design
- d) Price build-up shall include, in addition to cost of material.
- e) Cover blocks of PVC or concrete.
- f) Spacer bars, chairs and unauthorized overlaps (Allowed for convenience)
- g) Cutting, bending, placing and fixing in position.
- h) Binding wire as approved.
- i) Wastage / Rolling margin.
- j) Cleaning of bars.
- k) For purpose of reconciliation, maximum wastage permitted shall be 5% of the actual material used. Balance amount shall be borne by the Contractors.

1.12.2. OPENING/INSERTS

- a) All required openings and pockets should be provided as detailed in the drawing with Hilti core cutter or sanitary pipes, fire pipes, rainwater pipe and pipes for other services as per project requirement. The contractor shall provide for the required materials, labour, for fixing and supporting during concreting. In his quoted price. It is imperative that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved. All openings/pocketed shall be in a correct line and level. After concreting, the openings shall be secured against any accident by proper covering and guardrail and warning notice, if any.
- b) The contractor shall clean and grout the pocket at a later date with a non-shrinking compound added to the grout mix or non-shrinking cement shall be used. It shall be well-cured and protected to correct line and level till handling over.
- c) Inserts are material such as timber, steel, plastic, and dowels. Bolts, locks, brackets, pipes, etc. left in concrete partly or fully embedded to receive connection with foreign member at a later date. These may be fabricated by the contractor or provided by the EMPLOYER as received from specialist, manufacturer, etc. These shall be protected from weathering and damage in course of the construction. The cleaning required after concreting and any treatment such as oiling, greasing or covering with paint etc. shall be carried out by the contractor at his cost.

SECTION – V TECHNICAL SPECIFICATIONS - CIVIL**1.12.3. General:**

- 1.12.3.1 These specifications shall be read in conjunction with the latest, specifications. In case these specifications are found wanting in any way the relevant C.P.W.D. specifications shall apply.
- 1.12.3.2 Materials to be approved/Best Quality: The whole of the materials, employed in connection with the permanent work, shall be new and of the best of its kind. All materials shall be in accordance with these specifications and shall be as approved by the PMC/ BANK.
- 1.12.3.3 Standards: Except where otherwise specified and permitted by the PMC/ BANK, all materials shall conform to the latest edition of Indian Standard Specifications.
- 1.12.3.4 All Specialized work such as Termite treatment, Metal doors and windows, tiling, roof insulation, water and damp proofing, structural steel work, glazing, dropped ceiling, painting, and rendering, road work, all plumbing, sanitary and electrical work, fittings and fixtures and horticulture work etc. shall be got done/fabricated erected/installed by approved specialized agencies.

1.12.4 EARTH WORK**General:**

Excavation, Backfilling and Leveling: Excavation shall conform to the limits indicated on the drawings and shall not be made below the levels fixed by the Architects or Consulting Engineer except where rock is encountered or for removal of unstable materials is required and any additional cost for additional offset shall be borne by the contractor. Unless otherwise specified provision for shoring / structuring / packing, pumping, dredging and bailing out water whether subsoil or rain water shall be at the contractors own expense. Rock excavation shall include removal of ledge rock, concrete or masonry structures which required drilling or controlled blasting and boulders larger than half cubic yard in volume where trenches are in deep or bad grounds, the sides of the trenches shall be supported with suitable timbering. Trenches shall be backfilled in selected excavated materials in 200mm layer and carefully rammed and consolidated with addition of water if required, and compacted to 95% of maximum density at optimum moisture content to preclude subsequent settlement.

1.12.4.1 INDIAN STANDARDS

All relevant Standards as specified elsewhere in this Volume are applicable. Indian

Standards to be followed are:

- | | |
|------------|--|
| a) IS 1498 | Classification and identification of soils for general Engineering purpose. |
| b) IS 3764 | Safety code for excavation Work. |
| c) IS 4081 | Safety code for blasting and related drilling Operation. |
| d) IS 6313 | Part –1 Code of practice for anti-termite measures in buildings: constructional measures. |
| | Part –2 Code of practice for anti-termite measures in buildings: Pre constructional chemical treatment measures. |

e) SP 27 Hand book of method of measurement of buildings works.

f) Explosive Rules 1940.

1.12.4.2 SITE CLEARANCE

1.12.4.2.1 Prior to the start of any activity of earth work the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, trees and saplings of girth up to 30cm measured at a height of 1 meter above ground level. All rubbish must be removed and stacked at distance of 50 cm outside the periphery of the area clearance or location as decided by the PMC/ BANK.

1.12.4.2.2 The rate of such clearance is to be included in the rate of other earth-work items.

1.12.4.3 SETTING OUT

1.12.4.3.1 Bench Marks and Reference Lines shall be finalized by the PMC/ BANK. The contractor shall prepare detailed setting out drawings based on the layout of Architectural drawings and those shall be submitted to the PMC/ BANK prior to commencement of work.

1.12.4.3.2 The contractor shall do the setting out with the use of Theodolite or like instruments at site, based on details given to him/her. He shall erect timber profiles, masonry pillars, burjis etc. for his use. All markings on these shall be painted with red colour and they shall be maintained for the entire duration of the project. Setting out shall be approved by the PMC/ BANK before the commencement of any work.

1.12.4.3.3 The rate for the earth work items shall include expenses for all such work including labour, material and equipment / instruments etc.

1.12.4.4 EXCAVATION IN SOILS

1.12.4.4.1 Surface dressing

Trimming of natural ground, excavated surfaces and filled up areas to remove vegetation and / or small inequality not exceeding 15 cm in depth shall be described as surface dressing.

1.12.4.4.2 Rough excavation

Excavation not requiring dressing of sides and bottom and reduction to exact levels, such as winning earth from borrow pits, hill side cuttings, etc. shall be described as rough excavation.

1.12.4.4.3 Trenches for pipes / cables

It shall be detailed with nominal dia of pipe / cable. Required bottom width allowance for concrete foundation for laying pipes, working area, grip require for socketed pipe, return fill, ramming and removal of surplus soil shall be part of this item unless otherwise specified. It shall generally be measured in running meter unless otherwise noted in the BOQ.

1.12.4.4.4 Post holes

Independent post holes (or similar holes) each exceeding 0.5 cu m shall generally be enumerated. Rate shall include return fill, ramming and removal of surplus soil.

1.12.4.4.5 General

1.12.4.4.5.1 The excavated earth shall be thrown or disposed off beyond 50 m periphery of the

building. Earth suitable for backfilling shall be stacked separately. Subsequent disposal of the surplus and unsuitable material shall be as per the respective items. Foundations, trenches shall be dug out to the exact dimensions as shown in the drawing or as directed by the PMC/ BANK.

- 1.12.4.4.5.2 In firm soil, the sides of the trench shall be kept vertical upto a depth of 2 m. If the trench is to be deeper, it shall be in the form of steps of 50 cm, at every 2 m depth. This shall be suitably increased or decreased as per site conditions and type of soil met with. This shall be to the approval of the PMC/ BANK. Sloping of sides also may be adopted.
- 1.12.4.4.5.3 The bed of trenches shall be firmly consolidated and levelled by watering and ramming of the soft soil. Defective spots shall be dug out and filled with concrete of the same mix as of PCC or as directed by the PMC/ BANK. Cost of digging and filling with concrete shall be paid extra if excavation and PCC is measured separately.
- 1.12.4.4.5.4 If excavation is done to a depth greater than that required, excess depth shall be back filled with the same mix as of PCC or as directed. Cost of such concrete shall be to the contractor's account.
- 1.12.4.4.5.5 Excavated trenches shall have to be approved by the PMC/ BANK prior to laying of PCC or any other Permanent Work.
- 1.12.4.4.5.6 Excavation for drains shall be carried out with extra care to cut the sides and bottom exactly to the required shape, slope and gradient. Filling for excess excavation shall be done at the contractor's cost in consultation with the PMC/ BANK.
- 1.12.4.4.5.7 Excavated materials shall not be placed within 1 m of the edge of the trench or half the depth of the trench, whichever is more.
- 1.12.4.4.5.8 Excavations for column footings shall be carried to depths indicated in the drawings. Safe bearing capacity at such depth shall be verified to comply design requirements. If ordered by the PMC/ BANK, appropriate tests shall be carried out by the contractor.

1.12.4.4.6 Protection

- 1.12.4.4.6.1 Fencing and / or other suitable measures for protection against risk of accidents due to open excavation shall be provided by the contractor at his cost.
- 1.12.4.4.6.2 Where excavation is to be carried out below the foundation level of an adjacent structure, and to avoid underpinning, precautions such as shoring and strutting, etc must be taken. No excavation should start till such measures are taken to the satisfaction of the PMC/ BANK. Payments for such work shall not be made separately unless specified otherwise.

1.12.4.5 EXCAVATION SOFT ROCK

- 1.12.4.5.1 This shall be carried out by crowbars, pickaxes or pneumatic drills or any other suitable means. Blasting may be permitted if the contractor so desires but no extra money shall be paid for blasting. Measurement shall be in cubic meter.
- 1.12.4.5.2 Other general details same as clause (g) and its sub clauses.

1.12.5.6 EXCAVATION IN HARD ROCK (rock is also anticipated as per soil report)

a) General

On meeting hard rock that requires blasting, the contractor shall inform the PMC/

BANK. On approval in writing, blasting operation shall start if the contractor feels it

necessary and so desires.

- i. The contractor shall obtain the necessary license from the District Authorities for undertaking blasting work and explosive storing as per Explosive Rules 1940, and as updated. Explosive shall only be procured from an authorized dealer. He shall be responsible for the safe custody and proper accounting of explosives. The PMC/ BANK shall have access to the store.

- ii. The contractor shall be responsible for any accident to those working on the site, to the public or to property due to blasting operations.
- b) Precautions
- i. Safety measures to be adhered to shall be as detailed in IS 4081, Safety Code of Blasting (as amended from time to time, and to related drilling operations). Also digest No. 37 of C.R.C. and I.R.C.A. Road tariff No. 18 shall be adhered to.
 - ii. Blasting operation shall be carried out under the supervision of a responsible authorized agent of the contractor. Timings shall be as approved by the PMC/ BANK in writing. Lunch break will be preferred. The authorized agent of the contractor should be well conversant with the rules and regulations of blasting operations. Further the contractor shall be employing licensed blasters for actual operation.
 - iii. All proper precaution for safety shall be taken. All persons shall be moved away to a distance not less than 200m. All entries shall be sealed and red flags displayed at prominent places.
 - iv. Blasting shall be done only with gunpowder. Dynamite, gelignite, or any other high explosive shall be used only with written permission of the PMC/ BANK.
 - v. The number of charges to be fired and the actual number of shots heard shall be counted and the contractor's agent shall satisfy himself by examining that all charges have exploded. Only then shall workmen be allowed to start work. Unexploded charges shall be flooded with water, a new hole drilled and exploded again.
 - vi. The PMC/ BANK shall be informed about all misfires, their causes and the remedial steps taken.

CLASSIFICATION

1.12.5.7.1 All soils comprising any of the following:

- a) Vegetable or organic soil, turf, sand, silt, loam clay, mud, peat, black cotton soil, soft shale or loose murum.
- b) Any mixture of soils (a)
- c) Mud concrete below ground level.
- d) Generally any material which yields to the ordinary application of pickaxe and shovel or to phawra, rake or other ordinary digging implement and not affording resistance to digging greater than mentioned in (a) to (c)
- e) Stiff heavy clay, hard shale, or compacted murrum requiring close application or a grafting tool or pick or both and shovel.
- f) Gravel and cobblestone (cobblestone is a rock fragment), usually rounded, having maximum dia in one direction of 75-300mm.

Soft rock comprising any of the following:

- a) Soling of roads, paths etc and hard core.
- b) Macadam surfaces of any description, (water bound, grouted, tarmac, etc)
- c) Lime concrete, stone masonry, in lime mortar and brick work in lime or cement mortar, below ground level.
- d) Soft conglomerate, where the stones may be detached from the matrix with picks, crow which may be quarried or split with a crowbar.
- e) Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with a crowbar.

- f) Unreinforced cement concrete as well as reinforced cement concrete which may be broken up with crowbars or pickaxes and stone masonry in cement mortar, below ground level.
- g) Boulders nor requiring blasting, rock fragments usually rounded by weathering, disintegration and exfoliation or abrasion water or ice, having maximum dia length in any direction of 500 mm, found loose, embedded etc.
- h) Other varieties of rock which would normally be removed with pick, crowbars, wedges and hammer with only a little difficulty.

Hard rock comprising any of the following

- a) Any rock or cement concrete in excavation for which the use of mechanical equipment or blasting is required.
- b) Reinforced cement concrete.
- c) Boulders bigger than ½ cubic meter requiring blasting.
- d) Hard rock as in (a) to (c) requiring blasting but prohibited from doing so for any reason and excavation has to be carried out by chiselling, wedging or any other agreed method.

1.12.5.9 FILLING

- a) Filling shall be done where required with approved quality of earth. It may be from excavation and where possible, cutting and filling shall be done simultaneously to avoid double handling.
- b) Filling shall be done in layers not exceeding 20 cm in depth. Earth used shall be free from roots, grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 90% consolidation. Consolidation shall be by mechanical rammers or roller of minimum half-ton weight. Where the roller cannot work,

wooden or steel rammers of seven to ten kg weight with flat base of 20 sq.cm or 20 cm dia should be used. Labour for ramming shall be at least 1 for every 6 diggers. In embankment or banking, every third layer of earth shall be rolled and consolidated with power roller of minimum eight ton weight.

1.12.5.10 PLANKING AND STRUTTING

In case of deep trenches where the soil is soft and not capable of being retained without the help of support, planking / strutting as required shall be carried out. It shall be the responsibility of the contractor to take steps to prevent slide / collapse. Method of planking / strutting will be largely influenced by the type of soil encountered and as approved by the PMC/ BANK.

1.12.5.11 DISPOSAL OF SURPLUS EARTH

- a) Surplus earth shall be used to the maximum extent in the compound. Earth useful for filling shall be separately stacked as directed by the PMC/ BANK from time to time. Approved quality earth shall e used in the filling. It shall be consolidated as detailed and approved by the PMC/ BANK.
- b) Rate for excavation shall include sorting out of useful materials.
- c) All surplus and unusable earth shall be disposed off outside the plot but at a location approved by local authority and confirming to their specification. The constructor shall quote his rate for disposing off or carting away the items considering requirements and standards of the local authority with whose permission surplus and unusable earth shall have to be disposed off.

1.12.5.12 DEWATERING

Bailing or pumping out of water that may have accumulated due to rains, subsoil seepage, tidal waves, or any other means shall be carried on continuously and the area shall be kept dry for the following operations.

- a) Measurements
- b) Concreting or masonry work
- c) Shuttering and reinforcement
- d) Backfilling
- e) Line out
- f) Any other reason deemed fit by the PMC/ BANK.

1.12.5.13 SAND FILLING

The sand shall be free from any organic and deleterious materials as detailed in I.S. It should be suitable for compaction. Filling shall be in layers of 15 to 20 cm. Watered with optimum moisture content and mechanical rammers. Measurement shall be for compacted volume in cubic meters.

1.12.5.14 MEASUREMENT

The following shall not be measured separately and allowance for the same shall be deemed to have been made in description of the main item.

- a) Setting out works, erecting profiles, etc.
- b) Site clearance such as clearing of shrubs, brushwood, small trees not exceeding 30cm in girth measured at one meter above ground.
- c) Unauthorized battering or benching of excavation.
- d) Forming (or leaving) DEAD MEN or TELL-TALES in borrow pits and their removal after measurements.
- e) Forming or leaving steps in the sides of deep excavation and their removal after measurements.
- f) Excavations for insertion of planking and strutting.
- g) Removing slips or falls in excavations.
- h) Dewatering by bailing or pumping out of water in excavations from rains, sub-soil water, tides undercurrents etc.
- i) Slinging or supporting pipes electric, cables etc met during excavation or while carrying out any other item of work.
- j) Dressing, trimming of sides, leveling or grading and ramming of bottoms. Soils, soft rocks, hard rocks shall be measured as per SP 27 Part I except for the followings:
 - i. Filling shall be in cubic meter for consolidated volume. The lift shall be considered from made up ground level.
 - ii. Planking and strutting required to be left in position shall be measured separately.
 - iii. The PMC/ BANK's permission in writing shall have to be obtained for this. In no other case shall payment be made for planning and strutting, if carried out.
 - iv. Lead and lifts shall be as per the BOQ. Post holes, trenches for cables and pipes shall be measured as detailed in clause 5 and clause 4.6 and shall be part of the respective piping, cabling item.
 - v. Excavation shall be paid for in the PCC area, and level shown in drawings or as approved by the PMC/ BANK. Working space shall not be considered.

- vi. Back filling of foundation is part of excavation and not paid separately.
- k) Void percentage considered for computing net quantities shall be
 - i. - Loose Earth 20%
 - ii. - Hard Rock 40%

RUBBLE: The rubble shall be trap, granite, or any other approved stone and shall be sound, hard, tough, durable, dense, clean and free from laminations, soft spots, cracks, decay, weathering and other defects. The stones shall be broken rubble with water absorption as low as possible but not more than 5%.

The shape of the stones shall be regular as can be obtained by quarrying without attempt at shaping or dressing. They shall be sufficiently flat bedded. The stones shall be broken with the smallest dimensions equal to the specified thickness of soling. The length and breadth shall not generally exceed twice its thickness & each stone shall be in one piece for the full depth of soling.

Preparation of sub-grade: All the fillings shall be watered and compacted to get maximum consolidation. All the necessary trimming or filling for the laying of the soling inline and required grade shall be done. The sub grade shall be marked by stakes and strings for the required depth for laying of the soling.

Laying soling: Unless otherwise specified the thickness of the rubble soling shall be 23cm. The stones shall be closely hand packed on the prepared bed with the largest face downwards and in contact with each other. The stones shall break joints as far as possible. The full thickness of soling shall generally be made with one stone only. As the laying of rubble advances, the soling shall be hand packed by wedging and packing with stones of smaller size in the joints of the soling and driving them y crow bars and hammers, etc. so as to fill the voids as completely as possible. Such filling of the interstices shall be carried out simultaneously with the placing in position of the large stones and shall in no case be permitted to tag behind. The soling shall be laid and hand packed true to grade and level. The soling thus laid shall be finished by knocking out projecting stones and filling depressions by chips to come up to the required level.

Consolidating: The soling shall be watered and rammed with wooden rammers of approved weight. Hollows, which appear during ramming, shall be made good with smalls. Ramming and making good shall continue till a closely knot compacted surface conforming to the required levels is obtained. Earth on no

account shall be used for making good or blinding purposes and it approved by PMC/ BANK, sad or gravel as directed shall be used for blinding purposes. Water shall be lightly sprinkled if required and directed by the PMC/ BANK.

Rate to include: apart from others factors mentioned elsewhere in this contract, the

contractor's rate quoted shall include for the following:

1.12.6.1 Preparing the sub grade

1.12.6.2 Providing and laying rubble soling, including hand packing

1.12.6.3 Consolidating, watering, ramming and blinding with approved sand gravel as directed.

1.12.6.4 All labour, materials and use of equipments and tools required for carrying out the work, satisfactorily and lead and disposal of material and payment of royalty etc. ensuring complete work being Item rate tender, quoted amount by the Tenderer will be treated as final cost for the project.

1.12.6.5 Anti-Termite Treatment General:

Anti-Termite Treatment shall be as per ISI-6313 (Part II)-1971 and latest revisions AND shall be carried out by an approved specialist agency as approved and directed by the Architect to the following general specifications:

1.12.6.1 Materials:

'CHLOROPYRIPHOS' mollifiable concentrate conforming to IS: 6439-1978 in approved concentration in water emulsion shall be used. Chemicals shall be brought to site of work in sealed original containers. The material shall be brought in at a time in adequate quantity to suffice for Hand operated pressure pump shall be used for uniform spraying of the chemical. To have proper check for uniform spraying of chemical, graduated containers shall be used. Proper check should be kept that the specified quantity of chemical is used for the required area during the operation.

1.12.6.2 Time of Application:

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete should start when the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or soil is wet with rain or sub-soil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the sub grade for the floor.

1.12.6.3 Treatment of Junction of Wall and Floor:

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level, small channel 30 * 30 mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel up to ground level 150 mm apart and the chemical emulsion poured along the channel @ 7.5 liters / Sq.mt of the vertical wall or column surface so as to soak the soil right to bottom. The soil shall be tamped back into place after this operation.

1.12.6.4 Treatment of Soil along External Perimeter of Building:

After the building is complete, provide holes in the soil with iron rods along the external perimeter of the building at intervals of about 150 mm and depth 300 mm and filling these holes with chemical emulsion at the rate of 7.5 liters per Sqmt of vertical surface.

1.12.6.5 Vertical Surface:

In the event of the depth of the wall filling being more than 300 mm, the external perimeter treatment shall be extended to the full depth of filling up to the G.L. so as to ensure continuity of the chemical barrier.

1.12.6.6 Horizontal Surface along Perimeter:

Treatment of soil under apron (Plinth Protection) along external perimeter of building, top surface of the consolidated earth over which the apron is to be laid shall be treated with chemical emulsion at the rate of 5 liters per Sqmt. Of the vertical surface before the apron is laid. If consolidated earth does not allow the emulsion to soak through, holes up to 50 to 75 mm center both ways may be made with 12 mm diameter mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.

1.12.6.7 Treatment for Expansion Joints:

Anti-termite treatment shall be supplemented by treated through the expansion joint after sub grade has been laid 2 liters per linear meter of expansion joint.

1.12.6.8 Treatment of Soil Surrounding Pipes and Conduits:

When pipes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipe or conduit for a distance of 150 mm and to a depth of 75 mm before treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated unless they stand clear of the walls of the building by about 75 mm for distance of over 300 mm from Ground level.

1.12.7.1 Wooden Door Frames

a) Wood :

Wood/Second Class Teak Wood Wherever specified, best quality Wood shall be used for frame work, as approved. Wherever specified, second class teak wood shall be with individual hard and sound knot and shall not be more than 25mm in diameter and the aggregate area of all the knots shall not exceed one percent of the area of the piece. It shall be free from Spongy, brittle, flaky, brashly condition sapwood and borer holes.

b) Steel frames:

As specified in detailed bill of quantities and in conformity with relevant IS code.

c) Joints:

These shall be of mortise and tendon type, simple, neat and strong. Mortise and tendon joints shall fit in fully and accurately without wedging or filling. The joints shall be glued with approved adhesive, framed, put together and pinned with hardwood or bamboo pins not less than 10 mm dia. After the frames are put together press in position by means of a press.

d) Surface Treatment:

Wood work shall not be painted, oiled or otherwise treated before it has been approved by Engineer. All portions of timber abutting against masonry or concrete or bedded in ground shall be painted with approved bit mastic paint or with boiling coal tar.

e) Fixing in position:

Before the frames are fixed in position these shall be inspected and passed by PMC/ BANK. The frame shall be placed in proper position, and secured to walls or columns as the case may be with metallic fastener; iron hold fasts as shown in drawing or as directed by PMC/ BANK. These sills shall be embedded sunk in the floor to its full depth. The doorframes without sills, while being placed in position, shall be suitably strutted and wedged in order to prevent warping during construction. The frames shall also be protected from damage, during construction.

1.12.7.2 JOINERY

- a) **Timber:** Timber shall be first class hard wood. The timber shall be of good quality conforming to IS 4021 – 1963, seasoning and treatment shall be done as per IS 1141-1973 and IS 402-1962.
- b) **Plywood:** Shall be BWP grade conforming to IS 710 – 1975.
- c) **Block boards:** Shall conform to IS 1659 – 1969 BWP grade and shall be with 6 mm thick hardwood lipping.
- d) Adhesive used for wood work and joinery work shall conform to IS – 849 – 1957.

1.12.7.2.1 Timber :

Timber for use in unframed clean sawn wood work for wooden plugs, rough grounds fillets or the like shall be first class hard wood.

The surface of wood sections, boards, ply cutting if touching or embedded in walls etc. shall be treated with colourless wood preservative on all surfaces of a approved quality and make. Nails and spikes shall not be used in joinery works, but instead bamboo wood pins of proper size shall be used.

Where length of any member exceeds 3.00 meters, approved type of joint shall be provided without any extra cost.

Timber surface of all carpentry and joinery work shall be wrought and prepared smooth.

Wooden plugs for fixing timber fixture and fittings and the like shall be built into walls. Alternatively fill plugs made out of asbestos cement powder or PVC plugs sleeves shall be used wherever specified.

- 1.12.7.2.2** Vertical members of timber door (cupboard/ cabinets) frames shall be embedded at floor level if indicated. The bottom of shutters shall be 5 mm above the finished floor level.

- 1.12.7.2.3 Door shutters:** All door shutters (internal or external except steel shutters) for al

blocks shall be factory made flush door shutters conforming to IS specifications unless otherwise mentioned in the nomenclature of the respective item. Door shutters shall be of the following specifications.

- a) Phenol formaldehyde synthetic resin conforming to BWP types specified in IS- 848-1974.
- b) Contractor shall obtain the approval for the name of the manufacturer of the flush door shutters from the Project Manager / Architect before placing the supply order. While asking for the approval, copy of the "Bureau of Indian Standard" letter under which manufacturer has been authorized to mark the product with ISI marking should be attached. PMC/ BANK before giving the approval shall ensure that the validity date of license has not expired.
- c) **Testing of flush door shutters:** On receipt of the shutters at site the PMC/ BANK shall be entitled to get the samples of door shutters tested in any approved laboratory. From each lot of approximately 500 shutters, one shutter shall be selected at random by the PMC/ BANK. The balance shutters from the lot shall not be installed until the lab report is received confirming that the sample complies with the requirement of IS. The cost of replacement of the door shutters selected as samples, their transportation to the laboratory and cost of testing by the laboratory shall be borne by the contractor, and shall be deemed to be included in the Item rate rates quoted in Schedule 'A' Part I.
- d) **MS sheet door shutters:** These shall be of size as shown in drawing. These shall be fabricated out of MS tube of 35 x 35, 1.25 mm thick and MS sheet, 16 gauge etc. as per details given in section VII and as shown In drawings.
- e) **Window shutters:** These shall be of standard hollow steel reinforced PVC extruded profile sections with 5.5mm plain float glass, with EPDM gaskets and matching special hardware and fittings as per the manufacturer/fabricator specifications. The shop drawing shall be prepared and submitted by the contractor based on schematic design by the Architect. Unless otherwise mentioned in the nomenclature of the respective item
- f) The bottom of door shutters shall be 5 mm above the finished floor level.
- g) The contractor shall provide one sample piece of each type of shutter for approval and comments of the architect and Project Manager before mass production.

1.12.8.1 Flush Door

1.12.8.1 General:

All flush doors shall be of approved make external quality, laminated full solid core block board construction as per IS:2202 to IS:1959. They shall be faced on each face as required and shall have approved teakwood edge lipping. Block board core stock shall be of approved species of timber, well-seasoned and proofed against termites by preservative chemical treatment. Approved laminate of decorative flush doors and block boards adjacent to one another shall be selected so that they match, to the satisfaction of the Architect. Other doors shall be as mentioned in the nomenclature of the respective items

a) Size and Thickness:

Flush door and block boards shall be of the required size and thickness. Flush doors

shall be ordered to a size little more in width than shown on the schedule so that after trimming it fits the opening between rebates perfectly.

b) Louvers and Vision Panels:

Where shown in the drawing and schedule flush doors shall be provided with kiln seasoned hardwood louvers to match face laminate or glazed vision panels as per standard manufacturer's details. Size of openings shall be as shown in drawings.

c) Rebating:

In case of double leaves shutters, the meeting of the styles shall be rebated by one third of the thickness of shutter. The rebating shall be either splayed or square type. Where lipping is provided, the depth of lipping at the meeting of styles shall not be less than 35 mm.

1.12.8.2 Fittings

Details of fittings to be provided shall be as per the schedule of fittings shown in the drawings. All fittings shall be heavy duty of approved make.

1.12.8.2.1 Fixing in Masonry Openings:

a) Fixing with Lugs:

- I. Doors, windows and ventilators unit shall not be 'built in' as the work proceeds but opening shall be left out and frames fitted afterwards so that the minimum specified clearance between opening and unit frame is left around. The size of the opening shall first be checked and cleared of obstruction,

if any. The position of the unit and fixing holes shall be marked on the jamb. Necessary holes shall be made in the masonry and lugs not less than 10 cm long 15 x 3 mm size fixed in cement concrete blocks 15 x 10 x 10 cm size of 1:3:6 mix (1 cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size). The frames of units shall be set in the opening by using wooden wedges at the jamb, head and sill, (wedges shall preferably be placed near the points where a glazing bar meets the frames and be plumbed in position)

- II. After it, the frame shall be fixed with the lugs with 20 mm, long and 6.3 mm dia G.I. Counter sunk machine screws and nuts. In case of flush opening which are rendered smooth, wedges shall be removed and gap between unit and jambs shall be filled with cement mortar.
- III. In case of flush jamb with external 'fair faced' finished the gap between the opening and frame shall be filled with mastic from inside till it oozes out on external face. The oozing mastic shall be cleaned and flush pointed. The internal gap shall be filled with mastic to about 1/3 rd depth and the rest with cement mortar.
- IV. In case of rebated and jambs finished 'fair faced' externally the mastic shall be freely applied to the inside channel of frame, jamb and sill, so as to ensure a watertight joint. After the unit is firmly fixed in position surplus mastic shall be cleaned and flush pointed, as shown in drawing.

b) Fixing with Screws and Plugs:

In RCC work where lugs cannot be embedded due to reinforcement bars etc. rawl plugs or other approved of metallic fasteners such as Dash Fasteners of the required size and type as approved shall be used.

1.12.8.3 Rolling Shutters**a) General:**

Rolling shutters shall be of best quality and obtained from approved make. These shall include necessary locking arrangement and handles etc. These shall be suitable for fixing in position as specified i.e. outside or below lintel or between jambs of the opening. The door shall be push and pull type and also operated with chain crank as required.

b) Springs:

The springs shall be, preferably of coiled type. The spring shall be manufactured from high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions; the spring pipe shaft etc. shall be supported on strong mild steel brackets.

c) Guide Channels:

The guide channels shall be of mild steel deep channel section and or rolled pressed or built-up construction. The thickness of the sheet used shall not be less than 3.15 mm. The minimum depth of guide channels shall be 60 mm for clear width of shutters up to 3.5m and 75 mm for 3.5 m and above. The gap between the two legs of the guide channel shall be sufficient to allow the free movement of the curtain and at the same time closes enough to prevent the rattling of the curtain due to wind. Each guide channel shall be provided with a minimum of three fixing cleats to the walls or columns by means of bolts or screws.

d) Fixing:

Brackets shall be fixed on the lintel or under the lintel as shown with raw plugs, screws, bolts, etc. The shaft along with the spring shall then be fixed to the brackets. The shutters shall be laid on the ground and the side guide channels shall be bound with it with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and the cover frame/shall then are fixed to the walls through the plate welded to the guides. Fixing shall be done accurately in workmen like manner so that the operation of the shutter is easy and smooth.

e) Grilled Curtain:

Wherever specified, rolling shutter shall be provided with rolling grill curtain.

f) Finishing:

The rolling shutter together with guide channel, cover and accessories shall be supplied with two coats of approved primer and shall be painted finally with two coats of approved paint at site after installation, as specified.

g) Fire doors:

Providing and fixing in position 45mm thick single / double leaf one hour fire rated

door made with 0.80mm thick Galvanised steel sheet fully flush double skin door shell with seam joints at stile edges and internal reinforcement provided at top, bottom, and stile edges for fire rating. The internal construction of door shutter shall be specially designed Honeycomb structure with reinforcement. *The door leading on each floor to the fire escape staircase shall be Fire Door with 2 hours fire rating and shall be as per NBC/ I S code. The door shall have a panic bar and the entire arrangement is covered in the job.*

1.12.8.4 Metal Inserts in RCC & Block Work

1.12.8.1 General:

Anchor bolts, rolled steel sections sleeves, pipes, inserts, etc. shall be galvanized and shall be fixed or inserted as shown or directed. The Contractor shall supply and place in the shuttering all such inserts as may be required for sanitary, electric or work of any other trade. Work shall be done exactly as required for the purpose, to the satisfaction of the Architect. (For canopy and ducts)

1.12.8.5 Miscellaneous M.S. Works

a) Quality of Steel :

All mild steel used in this work shall be tough with even surface and shall cleanly rolled, sound and free from flaws, cracks, crop ends and other defects.

b) Workmanship :

All work shall be carried out as per drawing in a neat and good craftsman like manner by specially skilled men known for good quality work.

c) Assembly:

Work carried out in sections shall be carefully assembled. All members shall be secured together or to the anchors by welding or as shown in the details. All welds shall be ground smooth and made to match surrounding surfaces and finished to the satisfaction of the PMC/ BANK.

d) Setting in Lead:

Where the work is fixed to concrete it shall be set in lead. In exterior locations, the end of the main structural support near the point of embedding shall be cleaned and covered with a solar and a bronze sleeve or umbrella shall be set on the steel upright to cover the joint and sealed by blow lamp.

1.12.8.6 Powder coated Steel Doors and Frames with louvered/glass panels as per the drawings for Electrical Rising Main Shaft, Wet Riser Shaft, Fire/Telephone Shaft having all hardware fittings and locking arrangement

1.12.8.6.1 General:

Aluminum doors, windows, etc. shall be electro treated natural anodized free of scratches and any other blemishes or any other approved colour and shall be of sizes as shown on drawings. The details shown on the drawings indicate generally the sizes

of the component parts and the general standards. These may be varied slightly on approval to suit the standards adopted by the manufacturers of the aluminum work. Before proceeding with any manufacture, the contractor shall prepare and submit. Complete manufacturing and installation drawings for approval of the PMC/ BANK and no work shall be performed until the approval of these drawings are obtained. All requisite materials and labors as specified here under shall be fully covered under the rates prices for proper execution and completion of the work. Weather-strip, gaskets and sealants shall be of high quality material capable of resisting local environment exposure and performance requirements. Interior primary seal be a compression type weather seal.

1.12.8.6.2 Shop Drawings & Samples:

The contractor shall submit shop drawings and samples of each type of windows, ventilators and other aluminum work, glass doors, pumps and connecting pipelines for firefighting and water supply, foundation detailing for transformer, generator, solar water heater, solar PV panel, GA drawing of distribution panel, distribution boxes, pump panels, electrical panels and controls for air-conditioning work, lift well detailing for coordination with the lift supplier, detailed room-wise flooring pattern and stone cladding pattern as per general pattern advised by the architect, floor-wise reinforcement bar- bending schedule, structural glazing, glass canopy and layout cum shop drawing of the car parking (two tire stack system) to the PMC/ BANK for his approval. The shop drawings shall show full size sections of doors, windows etc. thickness of metal, details of construction, anchoring details, hardware as well as connection of windows, doors and other metal work to adjacent work. Samples of all joints and methods of fastening and joining shall be submitted to the Architect for approval well in advance of commencing the work. Samples of all sanitary fittings, wall tiles, floor tiles, granites, kota stone, marble, vitrified tiles, glass and glazing samples duly fixed on site, hardware fittings, balusters and railings, door frame and moulding, wall finishing with cement putty, shades of paints and coating, external inter-locking blocks, road kerbs, cement concrete tiles (duracrete), nosing of marble/stone, fixing of stone dado with approved quality of adhesive (exclusion of pure cement slurry) will be presented for approval well in advance.

1.12.8.6.3 Sections:

White PVC sections to be used for windows, ventilators and fixed glazing etc. shall be fabricated from approved extruded sections. The sections shall be extruded Built up standard tubular and other sections confirming to the prevailing standard of Fenesta (brand) or approved equivalent and free from all defects impairing appearance, strength and durability. The permissible dimensional tolerances of the extruded sections shall be such as not to impair the proper and smooth function/operation and appearance of doors and windows. For any excess weight of section used nothing extra shall be paid.

1.12.8.6.4 Fabrication:

Doors, windows, ventilators, etc. shall be fabricated by an approved specialist firm. All doors and windows shall have mechanical joints. The aluminum sections joints shall be designed to withstand a minimum wind load of 175 kg. per Sqmt. The designed sections shall also ensure that the maximum deflection of any framing shall not exceed L/175 of the span of the member. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The jointing accessories such as cleats, brackets etc. shall be of such material as not to cause any bimetallic action. The design of the joint and accessories shall be such that the accessories are fully concealed. The fabrication of doors, windows, etc. shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to supports and fixing of hardware and other fixtures as approved by the PMC/ BANK. The aluminum sections shall conform to the following parameters also:

- a) The minimum tensile strength shall be 19 kgf / mm².
- b) The maximum allowable deviation in length from a straight line shall be 0.5mm/metre.
- c) The maximum allowable deviation from straight shall be 1 degree.
- d) The maximum permissible twist shall be 0.5mm/metre.
- e) The maximum variation in flatness shall be not more than $0.125 * \text{Width}/25$.

1.12.8.6.5 Anodizing:

All surfaces of windows, ventilators & fixed glazing etc. shall be natural anodized or dyed to approved in approved shade to conform BIS: 1868-1968 Grading-8. Anodic coating shall be of a minimum thickness of 15 Micron . The testing shall be done by Eddy current method as per IS: 6012 for thickness and relevant test for sealing and colour variation measurements shall also be carried out. Sulphuric acid shall be used as the electrolyte for the anodic process. The anodizing shall be carried out in an approved manner to achieve the desired colour. Prior to anodizing all aluminum shall be rendered uniform in Appearance free from disfiguring scratches, stains or other blemishes and etched in a caustic soda solution.

1.12.8.6.6 Protection of Anodized Finish :

Requisite tests shall also be required to be carried out at site as instructed by the Architect and contractor shall arrange all assistance and equipment's required for these tests at site for which no extra payment shall be made to the contractor. All aluminum members shall be wrapped with self-adhesive non staining PVC tapes, approved by the PMC/ BANK.

1.12.8.6.7 Handling:

Fabricated materials shall be crated in an approved manner to protect the material against any damage during transportation. The loading and unloading shall be carried out with utmost care.

1.12.8.6.8 Installation:

Just prior to installation, the doors, windows etc. shall be stacked on edge on level bearers and supported evenly. If so specified or directed by the Architect, window/door frames shall be fixed to 25mm thick 2nd class hard wood rough ground. Width of rough ground shall be exactly the same width of the frames. Wooden rough grounds shall be fixed to masonry surrounds with approved fasteners.

The face of rough ground to receive frames shall be in true line, level and plumb. When the rough ground is properly secured and all major internal and external finishing works are over, the assembled doors/windows shall be placed in correct final position in the opening and fixed to rough block through cadmium plated machine screws of required size and spacing. Then all joints shall be sealed with approved silicon sealants. Sizes, details, spacing, etc. given above are approximate and indicative only. They can be varied at the option of Architect to suit particular sizes and situations and the contractor shall carry out the instructions of the PMC/ BANK in this regard at no extra cost to the owner. The contractor may suggest alternative methods of fixing and anchoring for consideration of the PMC/ BANK, while the decision of the PMC/ BANK in this regard shall be final and binding.

In the case of composite windows the different units are to be assembled first. The assembled composite units should be checked for line, level and plumb before final fixing is done. Units may have to be assembled in their final location if the situation so warrants. Where aluminum comes into contact with masonry, brickwork, concrete, plaster or dissimilar metal, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that is trimmed off to a clean line on completion. The contractor shall be responsible for assembling composite units, bedding and pointing with mastic inside and outside, at the transoms and mullions, placing the doors windows, etc. in their respective openings. After the doors/windows have been fixed in their correct assigned position, the open hollow sections abutting masonry/concrete shall be filled with cement grout (1 cement :3 coarse sand) densely packed and finished neat without causing any scratch/damage to Aluminum sections. Final packing grout shall be of the expanding type made by approved additive. The contractor shall be responsible for the doors, windows etc. being set straight, plumb, level and for their satisfactory operation after fixing is complete.

1.12.8.6.9 Epdm Gaskets:

EPDM gaskets of approved size and profile shall be provided and installed at all locations as shown and as called for to tender the doors windows etc. Absolutely air tight and weather tight. Samples of the gaskets shall be produced for approval and procure after approval only.

1.12.8.6.10 Sealant:

The gaps between frames and supports and also any gaps in the window sections shall be raked out as directed and filled with approved silicon sealant of approved colour and make to ensure complete water-tightness. The silicon sealant shall be of such colour, and composition that it would not stain the masonry/concrete work, shall receive paint without bleeding, will not sag, or run and shall not set hard or dry out under any conditions of weather. Silicon sealant shall be applied with special gun as per manufacturer's recommendation by a specialist firm approved by PMC/ BANK.

1.12.8.6.11 Fittings:

Nylon rollers, Stainless Steel frictional hinges, shutter end lift curbs, buffers, handles, locks and other fittings shall conform to the relevant I.S. specifications and quality and manufacture as approved by the PMC/ BANK. Fittings shall retain the casements rigidly in both the open and closed position; hinges shall be wrapped and protected until after the completion of the building. Hinges shall be close-up type and shall be opening as shown. These hinges shall work in conjunction with friction adjusters as a hold open device or additional friction for controlled operation. Rollers shall be heavy duty type and allow free sliding movements without any friction.

1.12.8.6.12 Final Cleaning:

The PVC wrapping, protecting and anodized finish shall be retained till the glazing work is commenced. After the glazing and all work connected with installation of windows is complete all aluminum work shall be washed with a suitable thinner and left in a finished condition, in approved uniform appearance and free from all marks and blemishes.

1.12.8.6.13 Glass Doors and glass fixed shutters as per Door Window Schedule with 12mm thick toughened glass and spider and other patch fittings, SS handles 1ft long (u-shaped) as per the drawing with locking arrangement in all the entry point of halls at all the floors and reception area as shown in the layout drawings.**1.12.9.1.1 Tiles:**

The tiles shall be of approved make/manufacturer. They shall be flat, and true to shape and free from cracks, crazing, spots, chipped edges and corners. The surface shall be of uniform shade except for patterned tile. The sizes of tiles shall be as directed. The thickness of the tiles min 5 mm unless otherwise required or shown

1.12.9.1.2 Colour and Pattern:

The tiles shall be (rectified type with straight edge cutting to obtain paper thick joint) white, coloured or patterned as specified.

1.12.9.1.3 Preparation of surfaces:

The joints shall be raked out to a depth of at least 12 mm in masonry walls, while the

masonry is being laid. In case of concrete walls, the surfaces shall be hacked and roughened with the wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting /dado is commenced.

1.12.9.1.4 Mortar:

5 mm thick plaster of cement mortar 1:3 shall be applied and allowed slightly to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at close intervals.

1.12.9.1.5 Laying of Tiles:

The tiles shall be soaked in water, adequately washed clean, and a coat of neat cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and butt jointed. The joints shall be as fine as possible and uniform. Top of dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Where full size tiles cannot be fixed these shall be cut to the required size and their edges rubbed smooth. Care shall be taken to ensure that as far as possible cut tile are in non- exposed locations. Works shall be carried out in all areas only after a sample panel has been approved by the PMC/ BANK.

1.12.9.1.6 Pointing:

After lying is complete, the joints shall be cleaned off the grey cement grout with wire brush and all dust and loose mortar removed. The joints shall then be flush pointed with white cement slurry added with approved pigments to match the colour of tiles.

1.12.9.1.7 Curing and Finishing:

The surface shall be cleaned and kept wet by sprinkling water for seven days. The finished surface shall be clear, free of patches and glossy and shall not sound hollow finished dry surfaces shall be washed with mild organic acid, if so required. The finished surface shall meet the approval of the Architect.

1.12.9.2 FLOOR FINISHING, SKIRTING, DADO AND PAVING:

- a) **Flooring:** Floors shall be provided inside the rooms, corridors, connecting corridors, passages, lobbies, Pantrys, toilets, baths WC's stairs, landings, verandahs, balconies and open terraces, ramps etc. Floor shall be laid to level and or to slope as shown on drawings and as required and directed by PMC/ BANK. Floor shall be carried through all the doors and other openings and over dwarf walls. Exposed edge of floors shall be finished in the same manner as for top surface. Skirting shall match with the floor finish unless otherwise specified.
- b) Finishes of the floors at various locations shall be as shown on various drawings / schedule of finishes.
- c) The specifications of various types of floors shall be as specified here-in-after.

1.12.9.2.1) Sub flooring/ base concrete under floor finishes of ground floor and platform

a) For ground floor areas:

Sub floors (base concrete under floor finish) **100** mm thick cement concrete in 1:4:8 (1

cement : 4 coarse sand : 8 stone aggregate 40 mm nominal size for all locations) shall be laid over a layer of fine sand 100 mm thick over rammed earth at ground floor only.

The floor shall be laid in level on the RCC slab of the main building on cement concrete 1:4:8 sub-base average (50 mm thick and necessary raceways shall be embedded as per detailed layout on each floor

b) For upper floors

- I. **Sunken / lower portion of slabs:** Sub base shall be in lean concrete in 1:5:10 (1 cement: 5 coarse sand: 10 brick ballast 40 mm nominal size)
- II. **Other floors:** 60 to 80 mm (avg.) thick as applicable lean concrete 1:5:10 (1 cement: 5 coarse sand: 10 brick aggregate 40 mm nominal size) laid over RCC slabs for building.

1.12.9.3. Plain cements concrete flooring:

- (a) For floors of electric niches, cupboards, cabinets, counters, shelf etc. 40 mm / 50 mm thick concrete floor 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm nominal size). The top surface shall be finished with floating coat of neat cement using steel float while the concrete is green.
- (b) Skirting: To match PCC floors 18 mm thick plaster in cement mortar of mix 1:3 (1cement: 3 coarse sand) finished with a floating coat of neat cement shall be applied to skirting. The skirting shall be 125 mm high as shown on drawing.

1.12.9.4. Polished kota / Granite stone in flooring and landing and treads/step in staircases:

The kota / Granite stone slabs shall be machine polished and of selected quality, hard, sound, dense and homogeneous texture, free from cracks decay weathering and flaws. They shall be machine cut to the requisite thickness. The edges shall be truly vertical the colour of the slabs will be approved by the PMC/ BANK, before starting of work. The slabs shall have the top (exposed) face polished before being brought to site. The slabs shall conform to the size required. The thickness of the Kota stone slabs shall be as specified in the nomenclature of the respective items.

- (a) Dressing: Every slab shall be cut to the required size and shape and fine chisel dressed in the edges to the full depth. The edges shall be rubbed with coarse sand or machine rubbed before paving. all angles and edges shall be true and square and the surface be true and plane.
- (b) Preparation of surface and laying: The sub grade concrete or lean concrete filling over RCC slab on which the kota / granite stone slabs are to be laid shall be cleaned, wetted and mopped. The bedding shall be with cement mortar of an average thickness of 25mm and mix 1:4 (1cement:4 coarse sand), over this bedding, neat gray cement slurry of honey like consistency shall be spread. The edges shall be pasted with pigment to match the shade of slabs. The joints shall be kept as thin as possible.
- (c) Polishing and finishing: The floor shall then be kept wet a minimum period of seven days. The surface thereafter shall be grounded with machine fitted with grit block No.60, then No.120 and finally with No.320.between every two successive grindings the surface shall be washed, cleaned and covered with a thin coat of cement in order to fill any pin hole that appear. After the final polish oxalic acid shall be dusted over the surface at the rate of 33 gm per square meter sprinkled with water and rubbed hard with mamdah block (pad with woolen rags).The following day the floor shall wiped with a moist rag and dried with a soft cloth and finished clean.

1.12.9.5. Skirting:

- (a) Preparation of surface and laying: the surface shall be chipped off the projections if any cleaned and wetted and 12 mm thick plaster of cement mortar 1:3 (1 cement : 3 coarse sand) shall be applied and allowed to harden .The plaster shall be roughened with wire brushed or by scratching diagonal lines 2 mm deep at approximately 7.5 cms center both ways. The back and edges of the stone slabs shall be buttered with coat grey cement slurry and set in the bedding mortar.
- (b) Cutting polishing and finishing: Cutting, grinding and polishing of skirting shall be done in the same manner as of flooring but by hand grinder.

Full size stone shall be used in treads and risers of steps.

1.12.9.6. Glazed Vitrified tiles in Dado for Toilets and pantry etc.:(Size 2'-0" X 4'-0")

- (a) Glazed Vitrified tiles of first quality shall be provided in dado of Pantry and toilets of all locations as per drawing. The tiles shall be set over screed / plaster 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand) to all surface, set and jointed with neat white cement slurry. The joints shall be neat and fine.

Size of glazed tiles both for toilets, Baths, WC and Pantry shall be as shown on drawings

Height of glazed tiles dado shall be for 2400mm for all toilets in all flats except for guest house where it will be laid up to ceiling as shown in drawing / schedule of finishes. In Pantry glazed tiles shall be done above Pantry platform upto 600 mm high on the entire wall perimeter covered by the platform, sink and drain board. The height of the glazed tile dado in these locations shall be as shown above platform. The glazed Vitrified tile dado shall also be provided below sink and drain board on the perimeter walls covered by drainage board and sink.

The glazed tiles shall be first quality vitreous china and of the approved makes

1.12.9.7. Working platform in pantry/vanity counter for toilets, etc:

Finish of working platforms in pantry: Finish of the working platform in Pantry shall be with 20mm thick black granite stone diamond cut. Granite slabs shall not be in more than two pieces for each side straight length of working plate from. Granite shall be jointed with white cement slurry pigmented to the same colour as that of the granite stone including grinding smooth and polishing complete. The front fascia of the Pantry platform shall be provided with granite stone of same shade as that of platform. The granite stone slab shall confirm to the samples kept in site Office the exposed edges of the granite stone shall be half rounded and as shown on drawing.

1.12.9.8. VITRIFIED TILES:

Providing and fixing of full body vitrified homogeneous tiles (Acid & Alkali Resistance) of size 800 X 800 or 1200 x 1200 mm of approved shade, with cement, slurry @ 2 kg per sq m over the bed of 20mm thick cement mortar 1:4 (1 cement: 4 coarse sand) with the gap of 3-4 mm between tiles on either side using 3mm thick PVC spacers, to be filled up with epoxy base. Grouting material manufactured by Roffe Construction Chemical or Ball Adhesive or Dr. Back shall be filled up to depth of the tiles. All the work shall be finished & completed as per the manufacturer specifications as directed by

the Architect/ Project Manager. These shall be of approved equivalent make.

The vitrified floor tiles shall be fixed with high polymer modified quickset tile adhesive by approved manufacturer and conforming to IS: 15477, using 5 kg adhesive per sq m of tile area, in average 3 mm thickness.

- 1.12.9.9. VITRIFIED CERAMIC TILES SKIRTING:** Where shown/ indicated in the drawing/schedule of finishes provide 100 mm high vitrified ceramic tile & skirting over 12 mm thick cement mortar 1:3(1 cement : 3 coarse sand) and jointed with grouting material as specified above.
- 1.12.9.10. Paving with interlocking block:** Interlocking blocks paving / flooring shall be laid over 100 thick PCC over 50 thick sand, including vibrating the sand layer for compaction.
- 1.12.9.11. False Ceiling Work:** The false ceiling work shall be as per specifications and shall be co-ordinate with the air-conditioning installation and allied piping for the split unit VRV system. The outdoor units shall be placed on terrace and insulated refer grant piping shall be routed by making suitable diameter punctures in the RCC slab with electrical concrete core cutters of M/s Hilti or M/s Bosch. There shall be at least three trap doors per floor plate.
- 1.12.9.12. Partitions and Furniture** Some additional internal partitions and furniture shall be supplied, executed by other agencies and contractor shall progress the work in such a manner that the lower floor is finished so that the building can be ferreted and put to use at the earliest. The work shall be coordinated with PMC/ BANK
- 1.12.9.13. Sub-Station Equipment** The erection of equipment in sub-station shall need careful pre–construction stage planning by contractor.
- 1.12.9.14. Fixing Detail for Plumbing and Sprinklers** All sewerage/ wastewater/ vent/ water pipelines shall be of cast iron as per specifications. Suitable diameter holes shall be made in floor slabs with concrete core cutters and the pipes shall be routed by suspending with suitable split pipe support clamping system of M/s Intello Industries or equivalent having EPDM rubber lining with zinc-coated suspension rod of 10mm/8mm dia for roof hanging and work shall be as per recommendations of the manufacturer. For cast iron pipes, CI collar clamps or and TOR CI collar clamp shall be used when the pipe is in vertical position.
- 1.12.10. WATERPROOFING**
- 1.12.10.1. WCs SANITARY BLOCKS, PANTRYS, NAHNI BELOW SINK WASHING PLACES, Etc.**
- 1.12.10.1.1. BY SURFACE METHOD**
- Before the work is started, all cutting or chasing in the floor and / or walls and all the plumbing work should be completed and the normal plaster to the ceiling and upper part of walls should be provided. The treatment shall starts with filling in the depressed or sunken portions of the WCs and bathrooms, etc. with waterproof brickbat coba in cement with necessary gradient for easy flow away of water towards the Nahani trap or soil pan. The brickbat coba with covered with 18 mm thick approved waterproof layer which shall be continued on the walls above the floor level up to a height of 1 m . In the shower area of the bathrooms, the treatment shall be of full heights of the walls.
- 1.12.10.1.2. WATERPROOFING WITH CEMENT QUARTZ SAND & CHEMICAL INGRADIENTS**

a) General

Cementitious, two-component waterproofing membrane. It comprises a mixture of cement quartz sand and a special blend of chemical ingredients of an inorganic nature. 100% compatible with all masonry structures. It is seamless, liquid-applied, efflorescence free and is used against active water pressure. Due to its excellent adhesion and tensile strength, it can be easily applied to both horizontal and vertical surfaces.

b) Surface Preparation

- a. All new concrete plaster or screed surfaces shall be cured for a minimum of 28 days before doing waterproofing/chemical treatment. All concrete, plaster or screed surfaces shall have a wood float finish.
- b. All surfaces to be applied with the waterproofing compound and shall be cleaned by water blasting, sandblasting, wire brushing, scraping or any other suitable means to remove dirt, grease, moss, moulds, etc. Where necessary, detergent shall be used to remove oil stains and similar. A suitable algacide / fungicide solution shall be used to remove algae/ fungus.
- i. Other cracks that are subjected to only minimal movement shall be raked out where necessary. These cracks shall be repaired with waterproofing/chemical treatment or a similar epoxy repair mortar.
- ii. Where cracks are found to be structural, a structural engineer shall be consulted and the structure assessed.
- c. Large holes and defects shall be repaired by plastering or screening or using approved epoxy repair mortar
- d. All protuberances shall be rubbed down or ground flat.
- e. Patch work – All loose and flaky paint shall be removed. All sound smooth paint shall be lightly abraded to provide a key for adherence to the system.
- f. All spalled concrete and plaster must be repaired by appropriate methods prior to the installation of the Waterproofing System.

c) Waterproofing System Application

- i. Priming – Not required.
- ii. Mixing – Add Component A (powder), to Component B (liquid) in the correct mixing ratio and thoroughly mix with a mechanical mixer for at least 3 minutes. Mix only sufficient material that can be used up within its pot life (60 minutes).
Mix ratio: $A / B = 2.5 / 1$ by weight
 $A / B = 2.5 / 1$ by volume
- iii. Application – To a properly prepared damp surface, apply by brush, trowel, roller or spray equipment. Apply two coats of at 1.0 – 1.2 kg/m²/coat, giving an approximate thickness of 0.95 to 1.20 mm. Allow 3 hours drying time between coatings.
- iv. On the very next day after the System is completed, the entire surface shall be checked for pin- holes and holidays (areas not covered properly). Immediately, reapply the undiluted on pinholes and holidays areas.
- v. Allow at 24 hours before carrying out ponding test and or screening and tiling over.
- vi. If to be left exposed for a short time, the treated surface must be protected from direct sunlight frost, wind and rain. Canvas or wet Hessian bags may be used to protect surfaces. Curing can also be done by covering the hardened surface with

plastic sheets canvas. The total curing time takes 7 days. Back-filling can normally be carried out careful after 24 hours. Water retaining structures can normally be filled with water after three day ventilation should be provided in enclosed or humid areas.

- vii. Detailing - This shall be applied with. It is very important to pay special attention to corners, edges, and down-pipes, etc. as it will be these areas that failure is most likely to occur. All detailing shall be sufficiently reinforced and wrapped around to assure water-tightness. A minimum height of 150 mm from the finished level shall be maintained at all detailing and up stands.

1.12.10.2. TERRACES, CHAJJAS, CANOPIES, HORIZONTAL PROJECTION ETC.

1.12.10.2.1. BY SURFACE METHOD

The treatment will start directly over the RCC slab with laying over of approved waterproof brickbat coba in cement mortar to provide necessary gradient of 1 in 120 for the easy flow away of rainwater. Finally, the brickbat coba will be covered with joint less waterproof layer finishing the surface with 20mm thk jointless layer of cement mortar of mix 1:4 (1 cement : 4 coarse sand) admixed with water proofing compound conforming to IS: 2645 and approved by PMC/ BANK including laying glass fibre mesh of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300mm square 3mm deep as left in rough finish to receive china mosaic flooring on this treatment shall be carried along the inner side of parapet and / or other adjoining wall up to a height of about 300 mm in the shape of a round vata. The average thickness of this treatment shall about 100 mm with a minimum thickness at water outlets being 65 mm. This surface shall be rendered hard and tough, and suitable for all normal residential building use. Due to location of rain water pipes being far apart than 8m and/ or if the water is required to travel on one side only, then the thickness of the treatment increases proportionately to maintain the minimum gradient for easy flow away of rainwater and this additional thickness over and above 100mm thickness of the normal coba shall be measured and payable extra.

- a) Clean the surface from debris and loose mortar and other materials
- b) **Defect Check: Ponding the area:** Before final surface preparation, make the vatta for ponding to the entire area for 24hrs. To find the leakage & defective point mark the leaking & defective points on the slab for rectification.
- c) **Surface Preparation:** All surface to be waterproofed by the waterproofing/chemical treatment shall be cleaned by means of
 - Scrapping & chipping all loose mortar / material etc.
 - Wire brushing to remove dirt, dust, moulds etc.
 - Water cleaning & wire brushing to remove finer dust etc.
- d) **Rectification of Construction joints, Defective area & leakage points:**

Mark the construction joints on plan for record and easy location of joints Construction joints should be raked open by chisel in 'V' grooves. Defective (honey comb) & leakage points, shall be grouted by fixing the nozzle and grouting the same with cement slurry. Construction joints shall be re furnished to original profile by using

polymer mortar after pouring the cement slurry in 'V' grooves or grouting the same as and where required. An addition poly mortar layer min 15 mm thick over the 'V' groove min 10mm on either side of groove shall be laid.

e) Making coving (Watta)

All the spalled concrete and rough area must be smoothed by using cement mortar before application. Make coving in cement mortar at corner, edges, down pipes, slab and wall junction etc.

f) Product Application Primer:

After water cleaning the entire repaired surface apply waterproofing/chemical treatment primer by roller or brush as per the specified coverage rates.

g) Detailing :

Apply the thick coat of waterproofing/chemical treatment to the coving crack, construction joints and other rectified areas on slab min 50 mm on either side or 150mm to 230 mm to the upturns. A strip of chopped stand mat fiber shall be embedded to the bond coat. And another body coat to be applied over the fiber glass mat.

h) Application:

Apply the waterproofing/chemical treatment coat over the sufficiently dried primer in coats leaving at least 2 to 4 hrs interval between successive coats (depending upon drying time) in specified consumption ratio, using brush or roller. Next day: check for the pinholes and area not covered properly reapply another

i) Curing & Ponding Test:

After 72 hrs of Air curing fill the water for the ponding test for another 24 hrs for the leakage test

j) Protection of membrane:

After 24 hrs of ponding test check the area for leakage cover the membrane by screed or brickbat coba (as specified) laid in required slope and minimum thickness of 50mm at the lowest points.

k) Important note:

Surface to be waterproofed has to be thoroughly cleaned, dry and dust free. Surface must be protected after the application.

l) Detailing :

All smoothed corners and edged down pipes and coving (Watta) and other area of cracks, honey comb and joints etc. Where the failure is most likely to occur, the waterproofing/chemical treatment Application must be reinforced with fiber glass at upturns should be 100mm above for floor finish level

m) Curing :

Air curing does not require water curing. Surface must be protected from mechanical damage. Pinholes and area not covered properly by coating system to be treated by application of 1 coat of waterproofing/chemical treatment

n) **Ponding Test:**

Ponding test must be done to the treated area after 48 to 72 hrs of application the area shall be ponded for leakage testing.

Protection of the water proofing system area shall be covered by screed / Brick bat coba as per required slope with thickness 50mm min at the lowest point.

1.12.10.3. RCC UNDER GROUND & OVERHEAD TANK STRUCTURES: BY FORCE GROUTING AND SURFACE METHOD:

In the case of RCC underground and overhead water tank structures where there is no access available from outside and below the raft slab; the treatment is given inside with force grouting and surface method. The treatment shall start with forcing cement grout with W.P agent into the structure as and where found necessary. Thereafter, waterproof layer, finished smooth with towel in cement to be laid on the floor and continued on the side and partition walls up to their full height. Average thickness of this treatment to be 65 mm on the floor and 25 mm on the walls. All the fixtures like pipe sleeves, pipe inserts shall be fixed prior to taking up the above treatment. The water tanks must be filled up with water immediately after treatment.

Waterproofing Treatment to OH and UG tank

a) **GENERAL:**

Generally, all concrete surfaces shall be in a clean, sound and watertight condition, free of any dust, sand particles, oil and any other unwanted particles to the satisfaction of the Architect.

b) **WATERPROOFING MATERIAL:**

The waterproofing material to be used shall be a cementitious, ready mixed, efflorescence-free surface waterproofing membrane that consist of hydrophobic properties. Application of the Waterproofing Treatment can be applied by means of slurry coating, trowel or spray application. It can be either applied on the external surface or internal surface or both, depending on the thickness of the wall or floor. The shall consist of rapid-hardening Portland cement, specially treated and graded grain-size distribution, and special chemical ingredients of an inorganic nature. The cementitious waterproofing membrane shall remain waterproofed even under pressure and tested to 7.0 bar, and at the same time allow the concrete to "breathe" by allowing the passage of water vapor through the structure. In addition, the cementitious waterproofing material shall protect the concrete against ground water, aggressive ground water and certain chemical solutions. Cementitious waterproofing membrane shall be able to applied to surface or substrates such as concrete,

masonry and render that require proper sealing and protection against the influence of water and moisture. Inside wall and base of the tank will be finished with Gujarat-based white tiles.

c) PREPARATION OF SUBSTRATA:

Concrete to receive the treatment must have a clean surface and an open capillary system to ensure maximum bonding and sealing. All surfaces shall be examined for structural defects and remedied prior to the waterproofing treatment. Faulty concrete such as protrusions and honeycombs shall be chiseled and work back to sound concrete and cleaned (to be done by contractor). Construction joints that are not pre-treated with treatment, and cracks exceeding 0.3 mm widths, shall be routed out to a minimum depth of 25 mm and properly cleaned (to be done by contractor). From ties shall be removed and chiseled back to sound concrete (to be done by contractor). One slurry coat of Super shall be applied over all chiseled out areas, at a coverage of 1.5 kg/m². After the Super has reached its initial set and while Super is still "green" (about 30 mins after application), the chiseled out areas shall be filled with a cement sand mortar (to be done by contractor). Cracks that are found leaking shall be injected with VandexFlexin (separate quotation may be necessary), which is a modified acrylic resin. When in polymerized form Flexin shall be in an insoluble and nontoxic elastic mass, and shall not deteriorate within the structure. The plasticity and sealing capability of chemical shall remain constant in extreme temperatures ranging from – 40°C to + 70°C depending on circumstances. Flexin injection shall be injected directly into the defective area at pressure ranging from 10 to 320 bar, depending on the particular application.

d) WATERPROOFING TREATMENT:

Prior to the Waterproofing Treatment, all concrete surfaces shall be properly prepared and remedied as item C above. All concrete surfaces shall be cleaned and free from all forms of scales, laitance,

mould oil, curing agents and any other foreign materials. Extremely smooth concrete surface shall be roughened either by using abrasive disc, sand blasting, wet sand blasting, water blasting or acid etching (using 1-% Muriatic Acid Solution) to assure maximum bonding. All concrete surfaces to be treated with waterproofing material shall be thoroughly wetted down before application. The concrete surfaces shall only be moist (not wet), and laying water shall be removed leaving only a damp condition just prior to the application of the Chemical waterproofing Treatment. The waterproofing material shall be mixed in accordance with the manufacturer's instructions. Application by means of slurry coating shall be applied with a stiff masonry brush or stiff broom and worked into every irregularity on the surface. Chemical Waterproofing can also be applied by trowel or spray.

e) APPLICATION RATES:

Depending on locations, Chemical waterproofing cementitious waterproofing membrane shall be applied in thickness and coverage as recommended below:-

Ground Moisture	0.5 mm thick (3.0 kg/m ²)	Pressure less
Surface Water and Seepage	2.0 mm thick (4.0 kg/m ²)	Water Under Pressure
	3.0 mm thick (6.0 kg/m ²)	

f) CURING OF WATERPROOFING TREATMENT:

The Waterproofing Treatment, whilst setting, shall be protected from rain and direct sunlight. During hot, dry or windy weather conditions, curing shall be done using a constantly wetted matt, or constant application of a fine spray of water (like mist), to prevent the Vandex material from first drying out. Air circulation is necessary in enclosed areas to assure the normal setting of the Waterproofing Treatment. Waterproofing Treatment onto treated surfaces shall not be exposed to aggressive water, chemicals or acids until the Vandex treatment have reached its full strength, which normally take around 14 days.

DECORATION, COATING AND TILING:

Where the treated surfaces are to be decorated with paint, the Treatment shall be allowed to be cured for a minimum period of 4 weeks. The surface shall then be saturated with water and neutralized with a 1.8 muriatic acid solution. Following this, the area shall be thoroughly rinsed with water before any coating works. Paints and coatings to be used shall be vapor permeable. Where a plaster or render finish is required on top of the Treatment, it is essential that a thin rough cast of cement sand shall be applied onto the final layer of the Treatment shall be cleaned and an appropriate bonding agent be applied prior to the rendering.

g) Waterproofing to RCC Retaining Wall & Lift well in plinth with Chemical:

As per the specification of the approved manufacturer. The process should be got approved from Architect/Employer before commencement of said work ,well in advanced, unless otherwise mentioned in the Tender.

h) Defect Rectification:

All honey comb, crack and damaged area, shall be raked open to sound concrete up to min of 25mm depth, treating the same with two coats of Chemical and re plastering to the original profile with Cement mortar using Aqua Bond (Polymer) by the concern agency.

i) Construction joints:

Existing construction joints shall be chased out in 'V' groove up to a depth of 25 – 50 mm and apply 2 coats of Chemical and then fill the groove to original profile in Cement mortar using polymer / aqua bond. For stone coping, 10mm wide silicon sealant joint

shall be provided at a maximum distance not exceeding 4.5m.

j) Injection grouting :

Honeycomb, defective area and loose construction joints shall be grouted fixing nozzle and grouting with cement slurry as & where required after finding the leakage.

k) Roughening the surface:

Hacking to be done to the surface at least 85% of area to be hacked and water jetting to be used to remove the laitance for open capillary system.

l) Application of Chemical:

The surface must be cleaned thoroughly using water and also to ensure that the concrete is saturated. The surface water must be removed to make the surface damp only, prior to the application.

m) Mixing ratio:

part of Chemical 2 part of water by mechanical mixer (by volume) add water to Pot life: 15 min, mix only required quantity to be used in 15 min or as per the manufacturer's specifications.

n) Application:

Chemical slurry shall be applied in 2 coats on green surface (1st coat on damp surface & 2nd coat after 30 min over the 1st coat) at the specified coverage rate with the Chemical brush or as per the manufacturers specifications.

o) Curing protection:

Applied surface shall be protected from rain, water and direct sun light till the setting. Applied surface shall be cured for five days by constantly fine wet spraying on sprinkling.

p) Guarantee:

It shall be guaranteed that the building is completely water and leak proof for a period of 10 years. Such a guarantee shall be directly given by the specialist agency to the Employer in a form approved by the PMC/ BANK. In the event of failure of the waterproofing system at any time during the guarantee period, the specialist agency shall carry out such treatment as may be necessary to render the structure free from water leakage including breaking and reinstating any other works that may be necessary for the treatment at no extra cost.

1.12.10.4. ROOF COVERING, WATER PROOFING & RAIN WATER PIPES:

- a) Exposed roof at terrace floor level of all buildings and roof of staircases, mumty, except sloping roof shall be provided with water proofing treatment with brick coba and acrylic base waterproofing compound. The detailed operation of water proofing treatment with brick coba and acrylic base water proofing compound (on exposed roof terrace floor, roof of staircase, over head tank and mumty) shall be as follows :

- i. Clean the RCC slab surfaces including sides upto 300 mm high by wire brush

including raking and cleaning of construction joint if any.

- ii. Applying and grouting a slurry coat of neat cement using 2.75 kg. Per sqm of cement admixed with proprietary acrylic base water proofing compound conforming to IS-2645 over the RCC slab and sides upto 300 mm high.
 - iii. Lay 20 mm thick cement mortar 1:4 (1 cement: 4 coarse sand) admixed with proprietary acrylic based water proofing compound conforming to [IS-2645].
 - iv. A layer of broken bricks/ brick bats (coba) to be laid over the layer of 20 mm thick cement mortar (laid at (c) above) giving a gap of 15 to 20 mm and necessary gradient of 1:20 for proper flow of water. The joint/ voids to be filled with cement mortar 1:4 (1 cement : 4 coarse sand) admixed with proprietary acrylic based water proofing compound.
 - v. A gola in cement mortar 1:4 (1 cement : 4 coarse sand) admixed with proprietary acrylic based water proofing compound conforming to IS-2645 with brick bats embedded in it at the junction of horizontal surface and side wall.
 - vi. After two days of curing apply second coat of cement slurry admixed with proprietary acrylic based water proofing compound conforming to IS-2645.
 - vii. Finishing the surface with 20 mm thick joint less cement plaster 1:4 (1 cement : 4 coarse sand) admixed with proprietary acrylic based water proofing compound conforming to IS-2645 and finally finishing the surface with trowel with neat cement and making of 300 mm x 300 mm false square.
 - viii. 20 mm thick joint less cement plaster 1:4 (1 cement: 4 coarse sand) admixed with proprietary acrylic based waterproofing compound conforming to IS- 2645 over the gola upto 300 mm high on sidewalls. This plaster will be in continuation of plaster provided on horizontal surface as per sub para (vii) above.
 - ix. Average thickness of the above treatment shall be 120 mm and minimum thickness at Khurras is 65 mm.
 - x. The proportion of proprietary acrylic based water proofing compound to be used with ordinary Portland cement for all operations as aforesaid shall be laid down by the manufacturer of particular acrylic based water proofing compound.
 - xi. The whole treated portion shall be flooded with water for five days for curing and testing.
- b) Khurras:** Making khurras 450 x 450 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm nominal size) and laying 1mx1mx400microns PVC sheet finished with 6 mm cement plaster 1:4 (1 cement : 4 coarse sand) and coat of neat cement including rounding of edges and making and finishing the outlets complete.
- c) Gola / watta:** Providing coving 75 mm x 75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge) at the junction of RCC slab and wall including finishing exposed surfaces with cement mortar 1:4 (1 cement : 4 fine sand) as per drawing. Gola shall be done before the plaster of parapet.
- d) Balconies:** Finishing of balconies shall be as shown in the schedule of finishes with matching skirting. The specifications shall be as above :Roof slab at balconies to be finished as above shall be cleaned thoroughly and following treatment / covering shall be provided:
- i) For sunken / lowered portion of slabs. Treatment / covering as specified below.
 - ii) In portion of balconies which are not sunken / lowered treatment below”.
- e) Unplasticized rainwater pipes:**
- i. The rainwater pipes and fittings shall be provided with unplasticized PVC pipes conforming to IS- 4985-81 and ISI marked. The uPVC pipes shall be of outside

diameter as shown on drawings and of working pressure 4 kg / sq. cm. Internal and external surfaces of the pipes shall be smooth and clean, reasonably free from grooving and other defects. The uPVC pipes shall be jointed with PVC solution for concealed pipes and for exposed pipes with PVC collars by using lubricating solvent solution. Fittings shall be injection moulded or fabricators type conforming to IS-8008- 1976 (Part I and IV) and / or IS 8360-1970 (Part I to III) and / or as per manufacturers recommendations. The pipe shall start from ground level with bend as shown on drawing. A tee junction shall be provided at all terrace levels to collect water from Khurras and vertical pipe to be fixed properly with factory- made clamps of approved make such as Camry as per approval of PMC/ BANK, shall be extended upto top of parapet. At top PVC cowl shall also be fitted.

- ii. Cast iron chamber and grating at the top and outlet of every rainwater pipe shall be provided and shall fit in snugly on the socket end of the pipe. The perforations in the gratings shall be at least 60% of the total area of gratings.
 - iii. Where the rain water pipes are to be provided concealed within masonry the pipes shall be embedded in the walls with PCC 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate 20 mm down gauge) and wherever embedded in adjacent with RCC column or adjacent partly to RCC column and partly to brick work pipes shall be embedded in PCC 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) encasing all round. External surface of the pipes shall be painted with PVC adhesive and then coarse sand shall be sprinkled before embedding the pipe in the concrete for proper gripping with concrete. (d) Rainwater pipes running down along the walls / columns shall be firmly fixed to the walls / column at all joints and at one meter spacing on pipe with PVC clips as per manufacturer instructions. (e) Provide angled end pieces PVC shoe at bottom and splash stones 450 x 300 x 20 mm embedded in plinth protection.
- f) **PVC spouts:** PVC spouts shall be provided to balconies, upward turned chajjas and other similar locations. These shall be 25 mm dia., 300mm long PVC pipe of approve brand

g) Plastering and Rendering General

a) Scope :

This section shall cover internal and external plastering/rendering works as shown in the drawings.

b) Mortar :

The mortar of specified mix shall be used. Cement and sand shall be tested as specified.

c) Scaffolding :

Stage scaffolding shall be provided for plastering work as per Standard Practice and as directed by PMC/ BANK. This shall be independent of the walls.

d) Plaster to Extend:

All interior plaster shall be extended up to 12 mm below the skirting or dado level at no extra cost wherever required.

e) Preparation of Surface:

Joints of Concrete block work walls shall be raked-out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scraping. Shuttering imperfections of all concrete shall be roughened by hacking with chisel and all resulting dust and loose particles cleaned and the surface shall be thoroughly

hacked or bush hammered to the satisfaction of PMC/ BANK. The surface shall be thoroughly cleaned and kept wet as specified before plastering is commenced.

f) Approval of /PMC/ BANK to be taken :

No plastering work shall be started before all conduits, pipes, fittings and fixtures clamps, hooks, doors and window frames etc. are embedded, grouted and cured and all defects removed to the satisfaction of PMC/ BANK A sample of plasterwork shall be prepared and got approved before proceeding with the work. Special approval shall be taken from PMC/ BANK before starting each plastering work. No cutting of finished plaster shall be allowed. No portion shall be left out initially to be patched up lat on.

1.12.12.1 Exterior Plaster:

a) General:

Exterior plaster shall be 18 mm thick, unless otherwise specified, generally sand aced the base coat shall be about 12 mm thick with coarse sand applied after the base coat has set but not dried. The base coat shall be 1:4 (1 cement: 4 coarse sand) and second coat shall also be 1:4 cement mortar (1 cement: 4 coarse sand). Acrylic waterproof chemical @ 0.5 kg per 50 kg of cement or as recommended by the manufacturer shall be admixed with the plaster, wherever specified in the item.

b) Mixing:

The ingredients shall be mixed in specific proportions by volume. The mixing shall be done in a mechanical mixer or by hand mixing on water-tight platform. The cement and sand shall first be mixed thoroughly dry in the mixer. Water shall then be added gradually and wet mixing continued for at least a minute until mortar attains he consistency of a stiff paste and uniform colour. Mortar shall be used within 30 minutes of addition of water. Mortar which has partially set shall not be used and removed from the site immediately.

c) Application of Plaster

i. General:

Wall plastering shall be started after the completion of ceiling plaster from top and gradually worked down towards floor. It shall not, at any place be thinner than as specified. To ensure even thickness and a true surface, plaster pads of about 75 mm * 75 mm shall be first applied horizontally and vertically at not more than 2 m interval over the entire surface to serve as gauges. The mortar shall then be applied to the wall/surface between the gauges and finished even. All corners, junctions and rounding shall be truly vertical or horizontal and finished carefully. Generally work in an enclosure shall be completed in one day. For larger areas if the work has to be suspended at the end of the day, plaster shall be cut clean to line. When recommencing, the plastering, edge of old work shall be scrapped, cleaned and wetted with cement putty before restarting plastering

ii. Base Coat:

The mix shall be stiff enough to cling and hold when laid. On walls, the mix shall be laid in long even spreads upwards and across using sufficient pressure to force it into the key on the backgrounds. The mortar shall be laid as uniformly as possible. The average thickness shall not exceed that specified. This coat shall be allowed to stand firm till before scratching for key. The surface shall then be combed or cross scratched with a wire scratcher

iii. Second Coat:

A reasonable time (not more than 48 hours) shall be allowed after the application of the base coat for thorough drying before the application of the second coat. After soaking base coat thoroughly with water the mortar for second coat shall be applied with a feather edge rule to a true and even surface. The surface shall then be thoroughly scoured with a wood hand float, and any inequalities filled in. Over working shall be avoided. However, wherever special coating is specified, the second coat shall be finished smooth with cement based putty to the satisfaction of the PMC/ BANK.

iv. Single Coat Work:

Single coat work shall be finished smooth as specified in second coat work. Special care shall be taken to secure bond with the concrete/brick wall.

v. Plastering over Steel Surfaces:

Where plastering is to be done over steel surface, suitable expanded metal covering the steel surface and secured to the adjoining wall/concrete surface with an overlap of 200 mm shall be provided.

vi. Plastering at Junction of Masonry / R.C.C:

All junction of Masonry wall with R.C. structures e.g. column, beam etc. shall be plastered after providing and fixing of approved 100% virgin homopolymer polypropylene multifilament fibersmesh /pvc mesh 250 mm wide centrally over the length of junction either vertically or horizontally to the satisfaction of PMC/ BANK. G. I. Chicken Wire Mesh / 100% virgin homopolymer polypropylene multifilament fiber mesh of required width shall also be fixed over the chasing for conduits, pipes etc. on masonry wall before plastering is commenced.

1.12.13.1 WALL FINISHES**Internal surfaces**

- a) Cement plastering internally on all internal surfaces (except surfaces where other type of finishes have been indicated on drawings) including soffits of RCC slabs, beams, chajjas, lintels, all-round shelves, inner side of top parapets and loft walls etc. shall

be as under :

- i. 12 mm thick plaster in cement mortar 1:4(1 cement: 4 parts 75% fine and 25% coarse sand) mixed with 10% of lime water over brick and concrete surfaces. Dubbing out wherever required (i.e. bringing up the undulation on the rough face of brick work in level with proudest points) shall also be executed in the same mix along with rendering coat.
 - ii. 6 mm thick plaster in cement mortar 1:4 (1 cement : 4 fine sand) on soffits of RCC slabs, chajjas, lintels and Pantry / pantry, platforms, loft slabs, fins, fascia counters and all-round of cupboard shelves etc.
 - iii. 10 mm x 6 mm grooves shall be provided in ceiling plaster at junction of wall and ceiling.
 - iv. 12 mm thick plaster in cement mortar 1:4 (1 cement : 4 parts 75% fine sand & 25% coarse sand) mixed with water proofing compound
 - v. 12 mm thick plaster in cement mortar 1:3 (1 cement : 4 coarse sand) mixed with water proofing compound to be done on the internal surfaces of RCC / brick / parapet / gutter walls, chajjas, fins, fascia etc. including dubbing whenever required.
 - vi. 15 mm thick plaster in cement mortar 1:4 (1 cement: 4 coarse sand) shall be provided in internal surface of brick parapet wall at terrace levels.
 - vii. Before plastering it should be ensured that brick masonry joints are raked out (at least on even surfaces) to a depth of 12 mm and all concrete surfaces are rough enough for proper adhesion of plaster. If not they shall be made rough by hacking or bush hammering at intervals of 50 mm. Efflorescence if any dust / dirt shall be removed. The surfaces shall be wetted adequately before plastering.
 - viii. GI chicken wire/pvc mesh of 24 gauge / 100% virgin homopolymer polypropylene multifilament fiber mesh and 20 mm mesh shall be fixed all along RCC and brick joints in a width of 150 mm with end lap of 15 cm using cement slurry and nails etc. for fixing mesh before plastering.
 - ix. Sand used in plaster shall be within the grading zones as stipulated in the IS silt contents shall not exceed 4%. Brick surface shall be raked out at the end of day brick work to afford key to plaster. Plaster surface shall be hard and even without patchy appearance. If they flake or show scratch marks if rubbed by a pointed nail the plaster shall be rejected, dislodged and redone.
- b) **Drip course:** Drip course shall be provided to all projections, chajjas, facings, chopper etc.

c) **External Surfaces**

External surfaces at following locations shall be finished with 18mm thick plaster with necessary grooves and pattern as shown on the drawings and finally finished extra smooth with cement based putty.

- i. All sides of all the columns except internal sides of columns in Rooms and external faces of beams.
- ii. External surfaces of planters and external vertical surface of RCC over headwater tank.
- iii. Soffits of vaulted arched and flat soffits and bands.
- iv. All external plaster surfaces of the rest of all buildings, internal compound walls, external compound walls shall be finished in latex based paint – in three coats i.e. one coat of cement primer and two or more coats of snowcem paints to achieve even shade.

1.12.15.1 Painting, Varnishing and Rendering General

- i. Materials :**

All materials shall be the best of their kind and of approved manufacture for each item. Painting materials such as shellac, thinner, oils, driers, rollers, brushes, etc. shall be of the best approved quality and type. If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by PMC/ BANK shall be used.
- ii. Sealed Containers :**

Approved paints, oils or varnishes shall be brought to the site of work by the Contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least fortnight's work. The empty containers shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from PMC/ BANK.
- iii. Storage:**

All materials shall be stored in a neat and orderly fashion in one single clean space. Care shall be taken to maintain this place as clean and dust-free as possible.
- iv. Specialized Workmen:**

All work shall be done by the specialized skilled workmen experienced in the trade.
- v. Work as per Manufacturer's Instructions:**

All work shall be done strictly as per this specification and manufacturer's printed instructions. In case these specifications differ in any way from manufacturer's instructions, the latter shall apply.
- vi. Finished Surface to PMC/ BANK Satisfaction:**

All finished surface shall be required texture (smooth, rough or any other) and of even shade to the satisfaction of PMC/ BANK
- vii. Protection:**

All work done shall be thoroughly protected from damage at all times by suitable methods approved by PMC/ BANK. All other adjacent work or materials not received the finish at that time shall also be thoroughly protected by suitable canvas or paper covering or by other approved method.
- viii. Damages to be made good:**

Any damage or disfigurement of other works shall be immediately made good. All paint and varnish spots and other stains shall be thoroughly and carefully removed from all floors, doors, windows, fittings, furniture, glass, hardware and all other surfaces required, by approved paint removers and the places left clean and tidy

ix. Intimation before Starting:

No work under this section shall start without approval from PMC/ BANK.

x. Samples:

Before starting work under this section large size samples of all work shall be prepared by the Contractor for approval. Only after specific approval has been given to the samples, work shall commence. The actual work done shall be done as per the approved samples.

xi. Preparation:

All surfaces to be finished shall be thoroughly brushed and cleaned of mortar drops, dust, dirt, fungi, rust, mill-scale, efflorescence and all other extraneous material. All loose places and scales shall be removed by scrapping. Surfaces shall be thoroughly, sand-papered to a smooth finish. Further preparation work shall be done as specified under different types of finishes. Before starting painting all floors shall be washed clean and wiped dry.

1.12.17.1 OIL BOUND DISTEMPER:

- a) Oil bound distemper shall be provided to internal plastered surfaces of rooms where indicated on drawings and where directed by PMC/ BANK and Architect. The oil bound distemper shall be from manufacturers as approved by Project Manager and Architect.
- b) Before application of oil bound distemper, the surface shall be prepared by applying one coat of approved primer as per the directions given by the manufacturer. After the primary coat has dried the surface shall be lightly sand papered with zero grade abrasive paper, taking care not to rub out primary coat and then dust off. This surface so prepared before applying emulsion paint shall be got approved as a stage from the PMC/ BANK. After the prepared surface is approved, oil bound distemper shall then be applied in two or more coats to give smooth surface as well as even shade to the satisfaction of PMC/ BANK and the Architect.
- c) Cost of preparation of surface by application of primer and sand papering etc. shall be deemed to be included in the rates of application of oil bound distemper.

1.12.18.1 PAINTING :

- a) **Cement Base Paint:** Two or more coats of cement base paint over one coat of cement primer shall be applied to give even shade on all external cement plaster surfaces, internal cement plaster surfaces of parapets, top of parapets, inner face of gutter walls, soffits of chajjas, lintels, beams, and sills of windows etc. The shade of the paint shall be used as approved by PMC/ BANK. Each coat shall be cured well by wetting surfaces for at least three days.
- b) **Painting to wooden surfaces:** All exposed wooden surfaces shall be prepared and given a primer coat of approved quality as approved by the Architect. The surface shall then be bodied in with liquid wood filler of approved make, allowed to dry and rubbed with sand paper after moistening the surface with water, the surface cleaned then two or more coats of synthetic enamel paint applied to given an even shade of approved quality. Tint / shade of synthetic enamel paint shall be as approved by the MC / Architect.
- c) **Painting to Steel Surfaces:** All exposed steel surfaces shall be prepared, cleaned

with sand paper to completely remove scales and rusts and shall be painted with two or more coats of synthetic enamel paint to give an even shade over one coat of steel primer. The shade of synthetic enamel paint shall be as approved by PMC/ BANK.

- d) **Painting to PVC and CPVC Pipes:** All exposed pipes shall be painted by applying two or more coats of enamel paint. The shade and quality shall be as approved by PMC/ BANK.
- e) **Anti-Termite Solution to woodwork:**
- i. Anti-termite solution shall 'ASCUPS2' colourless or other equally approved preservative.
 - ii. Surfaces of timber which are in contact and / or buried in concrete / masonry / plaster and concealed surfaces of timber / board / plywood shall be treated with two coats of anti-termite solution before being built in or covered up.
- f) **Painting of concrete surface with epoxy paint of MRF or equivalent**

1.12.20.2 Cement Paint:

a) **Preparation of Surface:**

For new work, the surface shall be thoroughly cleaned of all mortar dropping, dirt, dust, algae, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the cement paint is applied. In the case of old work, all loose pieces and scales shall be removed and the surface shall be cleaned of all dirt, algae, oil etc. by brushing and washing. Pitting in plaster shall be made good and a coat of best quality water proof cement paint shall be applied over patches after wetting them thoroughly.

b) **Preparation of mix:**

Cement paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all cases the manufacturer's instructions shall be followed meticulously. The lids of cement paint Drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hygroscopic qualities.

c) **Application:**

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

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

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

d) Precaution:

Water cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

1.12.20.3 External Texture Paint

The paint shall be (Textured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint/100% premium acrylic emulsion paint) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in- Charge.

The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Finishing walls with ready mixed Premium acrylic emulsion paint (Company Depot Tinted) having VOC less than 50 gm/litre and UV resistance as per IS 15489:2004, Alkali & fungal resistance, dirt resistance exterior paint of required shade with silicon additives. 1.5MM -

1.8 MM Providing and laying weather and Ultra violet Resistant, Water Repellent, Dust, Dirt and Stain Resistant, Fungus and Algae Resistant natural none pigmented crushed granite Chips (100% natural crushed Granite chips/powder) of approved make with final coat of texture with stone chips (attainable thickness: 0.70 to 0.90mm to offer grooved finish) applied with Spray over a coat of texture without chips (attainable thickness: 0.50 to 0.70mm to offer smooth surface as base coat) over a repair check with exterior grade cement mixed with acrylic primer over a coat of acrylic primer tinted in approved shade water in the ratio of 1:1 complete as approved by PMC/Engineer in charge.

Finally, two coat of water base acrylic protection coat applied with roller and brush to make surface streak resistance.

1.12.20.4 Painting with Synthetic Enamel Paint

a. General:

Synthetic enamel paint (conforming to IS: 1932-1964) of approved brand and manufacturer and of the required colour shall be used for the top coat and undercoat of shade to match the top coat as recommended by the manufacturer shall be used.

b. Commencing Work:

Painting shall not be started until Engineer has inspected the items of work to be

Painted, satisfied himself about their quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm. Painting except the priming coat, shall generally be taken in hand after practically finishing all other builder's work. The rooms should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the taint work being started.

c. Painting on New Surface:

Preparation of surface shall be as specified above or as the case may be.

d. Application: The number of coats including the undercoat shall be as stipulated in the Item.

i. Undercoat:

One coat of the specified paint of shade suited to the shade of the top coat shall, be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

ii. Top Coat:

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

e. Preparation of Surface Wood Work:

The surface shall be cleaned and all unevenness removed as specified above. Knots if visible shall be covered with a preparation of red lead. Holes and indentations on the surface shall be filled in with glazier's putty or wood putty and rubbed smooth before painting is done. The surface should be thoroughly dry before painting.

f. Iron and Steel Work:

The priming coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scrapping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.

1.12.20.5 Stone work-

1.12.21 Dry cladding: -

The dry cladding shall be laid as per design with white sandstone 30mm thick gang saw cut stone with (machine cut edges) of uniform colour in sizes as approved by SBI/PMC in charge and in accordance with CPWD Specifications, including SS grade 316 or as specified, metal cramps, pins, dowels, ledges and supports, as per design and requirements. The support structure shall be designed by the Contractor and approved by the SBI/PMC in charge. Horizontal & vertical joints shall be filled with weather sealant mixed with pigment of matching shade. Groove width, if provided/ required, shall be uniform and in plumb of vertical surface.

The Contractor shall get this work executed through a specialized agency. The

Contractor shall submit the credential of the specialized agency well in advance for verification and only after written approval of PMC/Engineer in charge can the agency be deployed for this work. The Contractor shall furnish a legal guarantee bond for ten years in prescribed proforma certifying that all the defects noticed during this period shall be rectified and made good to the satisfaction of PMC/Engineer in charge.

Wherever the stone slab dry cladding is provided exposed to environment, exposed surface and edge surfaces of the stone slabs shall be treated to make the surfaces hydrophobic by applying water repellent / hydrophobic clear coating of water soluble silicate based impregnating agent of approved make. The formulation shall be prepared and applied as per the manufacturer's recommendations. Before applying the formulation, the surface preparation shall be done as per the manufacturer's recommendations. The surface shall be cleaned using water and the formulation shall be applied on the damp surface.

It shall be applied before installation of stone on vertical surface has been completed and after necessary surface preparation.

1.13 Aluminum Louvers system

Aluminium 50 BD Ventilated Façade / Louver System

Panel dimensions: 50mm wide x 100mm depth x 0.5mm thick, Panel length up to 5mtrs. Coil coated on a continuous paint line double baked. Roll formed from enamelled corrosion resistance Aluminium Alloy AA3005 / AA5050. Back cover matching panel length with end caps. Mounted in a module of 175mm on a mullion profile grooved by Locking Clip and Pop Rivet, Slotted Fastening Profile fixed at 200mm from panel ends and 1200mm centre to centre across panel span. Slotted Fastening Profile fixed to suitable sub-structure. Chromatised for maximum bond between metal and paint enamelled twice under high temperature. One side with full primer and finish coat (exterior), the other side with a primer coat (inner side), Green-pro certification for LEED certification by Indian Green Building Council (IGBC), ISO 9001:2015 Quality Management System Certification In-house Powder Coating line with Nano technology & catalytic converter in India Five (5) times cleaning process with Nano Technology for better adhesion and corrosion protection.

2 RAILING, GRILL WORK AND FENCING:

Railing, Grill & Fencing shall be as specified in the PART-D, Design Basis Report/Finishing Schedule or as specified in the Tender drawings. The work to be carried out as per latest CPWD Specifications. Brief Technical specifications of these works are as given below:

2.12 Grill Work:

- a. MS Grills shall be provided in the windows made out of mild steel sections or as specified in the tender drawings.
- b. All steel grills shall be according to the detailed drawings and shall confirm to Latest CPWD Specifications.
- c. On MS grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer and finished with two or more coats of low VOC synthetic enamel paint of approved make and shade/ powder coating as specified.

2.13 Railing:

The scope of the work includes preparation of the shop drawings (based on the tender / architectural drawings), fabrication, supply, installation and protection of the stainless steel railing till completion and handing over of the work.

- a. MS Railing: To be provided as per CPWD specifications as specified in tender drawings and DBR including painting & primer coat complete.

b. Stainless Steel Railing

- i. The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the PMC/Engineer in charge.
- ii. The Contractor shall submit shop drawings, for approval of the SBI/PMC in charge in- Charge, for fabricating stainless steel railing with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns. The details of the joints in the stainless steel railing including location, etc. shall also be shown in the shop drawings.
- iii. The Contractor shall procure and submit to the PMC/Engineer in charge, samples of various materials for the railing work, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of PMC/Engineer in charge / SBI. The material shall be procured and the mass work taken up only after the approval of the mock up by the PMC/Engineer in charge / SBI. The mock-up shall be dismantled and removed by the Contractor as per the directions of the PMC/Engineer in charge. Nothing extra shall be payable on this account.
- iv. The stainless steel shall be of grade 304 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.
- v. The required joints in the railing provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade. Nothing extra shall be payable on this account.
- vi. One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be procured in one lot from one manufacturer.
- vii. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.
- viii. The item includes the cost of all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc including cost of providing and fixing M.S. frames), T & P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.
- ix. The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.
- x. The item includes the cost of all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of PMC/Engineer in charge.

**2.4 Tremix (Vacuum Dewatered) Flooring
Base Preparation**

Sub-base: Well compacted granular sub-base (GSB) or PCC layer (M10 grade, 75 mm thick) over compacted earth.

Polythene sheet (minimum 125 micron) to be laid over base to act as slip membrane.

Concrete Mix

Minimum grade: M25 (1:1:2 nominal equivalent with approved design mix).

Water–cement ratio: ≤ 0.45 .

Slump: 75–100 mm.

Cement: OPC 43/53 grade conforming to IS 8112/IS 12269.

Placement & Compaction

Concrete laid in panels with approved bay size (not exceeding 4.5 m x 4.5 m).

Compaction by needle vibrators.

Screeding by straight edge and leveling guides.

Vacuum Dewatering Process

Dewatering by vacuum pump with filter mats applied within 30 minutes of laying concrete.

Vacuum pressure: 0.08 to 0.1 MPa, applied for 2–3 minutes per sqm.

Surface water reduced by ~15–20%, giving denser concrete.

Surface Hardening & Finishing

Dry shake floor hardener (min. 3–5 kg/sqm, metallic/non-metallic as per DBR) applied uniformly after dewatering.

Power trowelling and power floating until hard, level, and glossy surface is achieved.

Final finish: Smooth, level, dust-free, monolithic surface.

Jointing

Expansion and contraction joints provided at 4.5 m c/c or as approved.

Joints to be filled with approved sealant (polyurethane or polysulphide).

Edge strips with aluminium / steel to be used at bay ends.

Thickness

Parking basements: 100–125 mm RCC Tremix flooring.

Driveways/turning zones: 150 mm RCC Tremix flooring.

Thickness to be finalized based on load design.

Curing

Initial curing by covering with polythene sheets for 24 hours.

Final curing by water ponding/sprinkling for 7 days minimum.

Tolerances

Level variation: ± 3 mm in 3 m straight edge.

Thickness variation: ± 5 mm.

2.5 BUMPER GUARD STRETCHER GUARD CRASH RAIL SYSTEM & WALL GUARD

The scope of work includes providing & fixing Bumper Guard / Stretcher Guard Crash Rail System of approved make consisting of continuous aluminum retainer, impact absorbing strip (B-ABS), adjustable end cap / corner joint, adjustable adaptor plate and high impact vinyl acrylic cover of desired shade to withstand impact and providing a cushioned surface with its integrated rubberized absorber complete as per manufacturer's specifications.

- The Bumper Guard / Stretcher Guard Crash Rail System shall be able to protect walls that are susceptible to trolley traffic, preventing unsightly scuffs and costly damage.
- This system shall be so designed to withstand impact and provides a cushioned surface with its integrated rubberized absorber, making it ideal for areas like high traffic corridors, loading bays and light cargo lifts.
- Bumper Guard shall be manufactured from specially developed vinyl acrylic materials and has the following qualities:
 - a. Able to withstand high impact and abrasion

- b. Weather resistant and fire retardant
- c. Textured to provide an anti-slip surface
- Fittings and anchorages that can withstand corrosion when exposed to normal environmental conditions
- Easy to install and maintain

2.6 Wall Crash Guard: Corridors, Lobbies, Ramps of all the floors shall be provided with Wall Crash Guard as per approved drawings with following specifications.

Supply and fixing of CRUSH Rail of approved make having lead free vinyl snap on cover, PVC Holder and bumper of 2mm thickness each. Aluminum retainer of 2mm thickness that shall be fabricated from 6063-T5 aluminum having high impact resistance with size 157(+/-2) mm x 25(+/-2) mm with rail offset of 76mm along with continuous outside corner. The rigid vinyl profile shall resist an impact of minimum 30.4ft-lbs/inch as per ASTM D-25690b. The finished surface shall not support any fungal or bacterial growth in accordance with ASTM G-21. The system shall also confirm to class A fire rating. ASTM D-543 rating for assurance of chemical and stain resistance. All fixing and fitting shall be done as per manufacturer's specifications. Color and design shall be approved by PMC/Engineer in charge.

Column & Wall Corners Guard: All corners of walls and columns at corridors, lobbies and all inside area of all the floors shall be provided with Column & Wall Corner Guard up to a minimum height of 1.5m as per approved drawings with following specifications. Supply and fixing of corner guard of approved make and model Corner Guard having lead free vinyl snap on cover with PVC End Caps and bumper of 2mm thickness each. Aluminum retainer of 2mm thickness that shall be fabricated from 6063-T6 aluminum having high impact resistance with size 52mm x 52 mm. The rigid vinyl profile shall resist an impact of minimum 30.4ft lbs/inch as per ASTM D-25690b and shall not support any fungal or bacterial growth in accordance with ASTM G-21. The system shall also confirm to class A fire rating. ASTM D-543 rating for assurance of chemical and stain resistance. All fixing and fitting shall be done as per manufacturer's specifications. Color and design shall be approved by PMC/Engineer in charge.

2.7 SIGNAGE & ASSOCIATED WORKS

- a. The scope of the work includes preparation of the Architectural Drawings/ shop drawings based on details given in the tender drawings and as directed by SBI/PMC in charge. Fabrication, supply, installation and protection of the Signages shall be carried based on approved shop drawings.
- b. The item of work for the respective signage shall be confirming to Specifications/ tender drawings and shall cover all operations, fabrications and their installations and materials required for finished product.
- c. The signage work shall be got executed through specialized fabricator having experience of similar works. The EPC Contractor shall submit the credentials of such fabricator for the approval of the PMC/Engineer in charge.
- d. The EPC Contractor shall submit the Design, Size and installation procedure along

with samples to PMC/Engineer in charge for approval. Approved samples will be kept at site till the whole work is completed. PMC/Engineer in charge has right to modify the design of the approved samples and Contractor is bound to follow these written instructions / changes in design/ size etc. from PMC/Engineer in charge.

e. The typical patterns shown in the drawings are only indicative. The Contractor shall submit shop drawings, for approval of the PMC/Engineer in charge, for fabricating signage with detailing of frame work, if any, along with the fixing details. The details of the signage including

location, etc. shall be shown in the shop drawings.

f. The Contractor shall submit to the PMC/Engineer in charge, samples of various materials for the signage work, for approval. After approval of samples of materials, the Contractor shall prepare sample(s) for approval of PMC/Engineer in charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the PMC/Engineer in charge. The mock-up shall be dismantled and removed by the Contractor as per the directions of the PMC/Engineer in charge. Nothing extra shall be payable on this account.

g. The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform finish. Any defective work shall be rejected and redone by the Contractor at his own cost. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material. Nothing extra shall be payable on this account.

h. The signages shall be fixed with stainless steel anchor fasteners or other suitable arrangement for fixing the signage.

i. The entire work shall be carried out to the satisfaction of PMC/Engineer in charge. The Pictures shown for Internal Signages are for reference. The shape & Size of the Signages shall be as per the reference pictures. All the Internal Signages should Bilingual (English/Hindi). The colour of the print to be finalized after having a careful study of the Building Interior which shall be constant in all the buildings. The content of the Signages will be as per Architectural Plans.

j. The fabricator will keep a liberty to choose any one of the items between "IF, IG, IV, IX and IY", wherever they are mentioned/marked without hanging The text height which shall be constant. For Example, if at any particular location "IG" is marked, but the content gets fitted in "IY", the fabricator shall use "IY" in that location instead of using "IG". Similarly, if at any particular location "IX" is marked, but the content doesn't get fitted in "IX" with the standard font size used everywhere, but gets fitted in "IV", the fabricator shall use "IV" in that location instead of using "IX"

k. Way finding & Fire Exit signages suspended from Ceiling on corridors and other locations shall have content on both the two sides of the Signage for giving directions as per site requirement.

l. General Specifications of various types of Signages are given below: -

2.8 Automatic Sliding Door Operator

Providing and fixing automatic bi-parting sliding doors with 12mm clear toughened glass shutter.

Automatic sliding door operator shall be as per approved dwg., Compliant with European standards and produced according to the guidelines for power- operated windows, doors

and gates, BGR 232, the UVV and the VDE regulations. TÜV design tested, tested according to the low voltage guidelines, fulfils DIN 18650 standards for Pedestrian Safety, TUV Design Tested for Durability of 1 Million Cycles. The track profile should be separate from the main profile for enabling reduction in vibration insulation. Operator length = 6250 mm, Maximum clear passage opening width = 3000 mm, maximum clear passage height = 2500 mm, includes microprocessor controlled drive unit, with self-learning mechanism, program selector with knob, motion detector (eagle 6 radars, 02 nos), mechanical components, toothed belt, cover profile, floor guide for frameless glass (02 nos), glass clamping rail (02 nos), safety device-light barrier (01 pair). Body finish: standard silver anodised operator profile, electromechanical lock with 12 mm plain toughened frameless glass for complete elevation - 2 moving panels. UPS of 750 VA shall be provided, which will give power backup of 20 min. Only & if the duration of power cut to the operator is more than 30 min, then separate arrangement needs to be done for the same as automatic operator requires uninterrupted stabilized power supply. The above work complete in all respect as per approved shop drawings and to the satisfaction of engineer-in-charge / architect consultant.

2.9 Glazed Partitions

Supply and Fixing of Full Height Demountable Glass partition including doors with 10mm Toughened Glass using Frame profiles 100 x 25 mm up to a height of maximum 4m or as per drawing using minimum 20-micron matt finished Anodized Aluminum in required color & shade. The Fixed glass to be fixed using base profiles 100 x 25 mm at Top & Bottom & support profile 100 x 25 mm at sides. The profile size to be 100x25MM to be fixed on to the floor/wall/ ceiling as per the architect design. Over panel Profile of 100 x 50 mm to be used for Over panel, H Junction profile to be used at all Glass to Glass vertical joints, 90 Deg L Junction Profiles and T Junction profiles necessary as per design. End Profile 100 x 25 mm to be used for Open glass edges and all around the door frame with seals and Over Panel End profile including filling the joints if required with Silicon sealant structural grade and weathering grade of Dow corning - USA or "GE Silicon - USA" or "WACKER - Germany"., complete as per detailed drawings & approved shop drawings. (The contractor must provide detailed shop drawings of individual profiles and also details of any other profiles that may be used clearly indicating all dimensions.) The Profile shall be matt natural anodized, the Profile Manufacturer to supply all the necessary clips, seals and fixing accessories for the system. All Profiles to be with 2 mm Gauge thickness.

2.10 Glass Block

Glass Blocks (transparent / colour) of approved make of size 190mm x 190mm x 80mm (approximate weight 2.0-2.5 kg per block) with 10 mm joint to achieve a 200 mm module with mortar grout of white cement and marble powder in proportion of 1: 2 respectively including 6mm dia steel reinforcement bars to be laid in horizontal and vertical joints as per manufacturers specification.

Glass block panels shall be supported on all sides by fabricated powder coated (minimum thickness of powder coating 60 micron) aluminium frames of nominal dimension 80mm x 40mm x 2mm size, and block should rest on top of the cement mortar 1:3 (1 cement: 3 sand). Aluminium frames shall not be load-bearing and shall be fixed to the surrounding structure.

The joints between the blocks to be sealed with transparent / colour Silicone Gel sealant of approved make complete as per manufacturer specification, as per drawing and instructions of the Architect.

Location: Glass block shall be provided at various location & levels as per GFC architectural drawing. (Basic cost of Glass block excluding GST should not be less than Rs. 160/-).

2.11 Hardware for Glazed Partition single or double leaf doors

Providing & fixing Dorma or approved equivalent make stainless steel grade 304 patch fitting in frameless glass single or double leaf door shutters which include Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate and 'H' shape pull handle (450 mm x 25 mm) SS 304 grade and floor spring with adjustable spring strength, suitable for door leaf weight upto 120 kgs, max leaf width 1100mm and Tested for durability of 500,000 cycles &

other accessories including the cost of screw & all other incidentals complete as per detailed drawings & approved shop drawings.

2.12 Frame Less Door

Providing & fixing manual frameless double leaf glass doors with 12 mm clear toughened glass and S/S patch fitting (PT standard) of grade 304: such as Top pivot, Top patch, Bottom patch, Corner lock with EPC, lock keeper plate & stainless steel grade 304 handles 38 mm dia and 600 mm long or as approved by the Engineer in charge and floor spring conforming to DIN EN1154 with adjustable spring strength EN (1-4) and Tested for durability of 500,000 cycles. The above work complete in all respect as per approved shop drawings and to the satisfaction of engineer-in-charge.

2.13 Glazing with Patch Fittings

a. General

i. The Contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.

b. The scope of work shall include:

- i. Design, preparation of shop drawings, calculations, engineering data and test reports.
- ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.
- iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.

iv. Exposed Architectural mullions and other support members.

v. Finishes, protection coatings and treatments.

vi. Sealing with approved sealants within and around the perimeter.

vii. All thermal insulation, fire-safety etc. including supports and/or backing.

viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.

ix. Electrical bonding and earthing of all metal cladding elements.

x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.

xi. Glass and glazing.

xii. Transportation, storage, handling, protection and cleaning.

c. Submittals

i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.

ii. Shop Drawings

d. Fabrication and installation details, including followings

i. Plans, elevations and sections.

ii. Details of fittings and glazing.

iii. Hardware quantities, locations and installation requirements.

e. Sample for verification, for each type of exposed finish required for

i. Metal finish: 150mm long section of patch fittings, rails and other items.

ii. **Glass: 150mm square, showing exposed edge finish.**

f. **Materials**

i.

- Glass shall be as specified in drawing or as per design requirement. It shall be hard coated reflective bronze and heat strengthened glass. It shall be of approved make.
- In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

ii. **Components**

- Patch fittings: Stainless steel clad aluminium
- Floating Transom Bar: Steel clad in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.
- Rails: Stainless steel clad aluminium.
- Accessory Fittings: Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.
- Anchors and fastenings: Concealed
- Weather stripping: Sweep type

iii. **Hardware**

- Hardware should be heavy duty in matching finish
- Concealed Floor Closer and Top Pivots
- Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.
- Swing: Double acting; Positive dead stop, concealed with hold open angle Delayed action closing
- Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.
- Push-pull set: Stainless steel finish
- Lock set of approved make.

g. **Fabrication**

- i. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tempering glass. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.
- ii. Factory assembled components and factory installed hardware to greatest extent possible.

h. **Execution**

- i. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.
- ii. Install all glass system and associated components according to manufacturer's written instructions.
- iii. Set units in level and plumb.
- iv. Maintain uniform clearances between adjacent components.
- v. Lubricate hardware and other moving parts according to manufacturer's

written instructions.

- vi. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.
- i. **Cleaning**
 - i. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.
 - ii. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.
 - iii. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.
 - iv. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.
 - v. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer – in - charge.
 - vi. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.
 - vii. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.
 - viii. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.
 - ix. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.
- j. Performance Guarantee:

The Contractor shall offer a minimum of 10-year Performance Warranty for the entire installation carried out.

EXTERNAL FAÇADE WORKS:

1. Structural Glazing System

Scope of Work

The Contractor shall design, engineer, test, fabricate, deliver, install, and guarantee all construction necessary to provide a complete structural glazingsystem to the proposed building, all in confirmity with the Design Basis Report & Drawings as given. Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the Drawings and/or without limiting the generalities of the foregoing, the structural glazing Systems shall include, without being limited to, the followings:

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

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

All thermal insulation associated with the system. All fire protection associated with the system.

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

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

Isolation of dissimilar metals and moving parts.

Anticorrosive treatment on all metals used in the system. Polyester powder coating aluminium sections.

The Contractor shall also be responsible for providing the followings:

Engineering Proposals, Shop Drawings, Engineering data and Structural Calculations in connection with the design of the structural glazing System.

Scheduling and Monitoring of the Work. Mock-ups, samples and test units.

Performance testing of the structural glazing framing and glazing assembly.

Co-ordination with work of other trades. Protection.

All final exterior and interior cleaning and finishing of the structural glazing System As-built record drawings and photographs.

Guarantees and Warranties.

All hoisting, staging and temporary services.

Conceptualising and design of a suitable maintenance system for structural glazing.

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

The structural glazing system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects. Specific details should be designed to accommodate thermal and building movements.

a. Building Regulations

Structural glazing shall comply with all Government Codes and Regulations including IS codes, if any.

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

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

No cladding element shall sustain permanent deformation of failure under loading equivalent 1.5 times the design wind pressure specified. The design loads shall be considering Important building with life expectancy of 100 years, local external co-eeficients & internal co-efficient in accordance with codal requirement.

b. Pre Execution Requirements

i. **Design Proposals**

The Contractor shall propose the final design in such a way that all basic functional and architectural requirements in line with the Master Plan, Concept Plans & Design Basis Report are fulfilled and get the same approved by SBI. However, basic design requirements as described in the specification and other Architectural requirements such as the size of window, net glass area, ventilator, configuration of windows and spandrels shall be retained.

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

including:

- Request details as indicated on the tender drawings.
- Metal quality, finishes and thickness.
- Glass quality, coating and thickness and proposed manufacturer's brand names.
- Sections of the mullion and transom together with structural calculations.
- Arrangement and jointing of components.
- Field connections especially mullion to mullion and transom to mullion. Fixing and anchorage system of typical wall unit together with structural calculations.
- Drainage system and provision in respect of water leakage in the curtain wall/structural glazing system.
- Provisions for thermal movements.
- Sealant and sealing method.
- Glazing method.
- Wind load and seismic load and any other specific load considered in the design.
- Lightning protection link-up system of the curtain wall/structural glazing for connection and incorporation into the lightning conductor system of the building. Design concept must be stated in the proposal.

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

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

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

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

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

ii. **Samples**

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

iii. **Preliminary Programme**

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

- iv. Upon approval of the shop drawings, at least 4 copies shall be submitted by the Contractor.
- v. The Contractor/Sub-Contractor shall submit a maintenance manual for the curtain wall/structural glazing system inclusive of all metal parts, glass and finish etc.
- vi. During detailed design and execution any details may increase as per actual requirement at site, these variations shall be executed without any extra cost implications to the SBI.

c. Execution- Performance Testing

The performance tests are to be conducted on the structural glazing system, if the area of the structural glazing system exceeds 2500 Sqm from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science and Technology, India. The decision of the PMC/Engineer in charge about the necessity of testing of shall be final and binding.

d. General Requirements

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

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

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

Test procedures test schedules and test locations shall be submitted to SBI/PMC in-charge for approval before testing.

Prior to fabrication of Test Units, the Contractor shall submit shop drawings and calculations of the Test Unit for the PMC/Engineer in charge's approval.

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

ii. Test of Wind Pressure

The equivalent load of wind pressure or wind suction shall be given to the Test Unit as increasing or decreasing the inside pressure in the 'Pressure Chamber' at which the Test Unit is fixed.

The static wind pressure shall be applied design requirement (minimum 1.5 Kpa) at maximum wind pressure. The variation of dynamic pressure shall be of any approximate sine-curve- line.

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

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

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

- 1/175 of the span between supports or 20mm, whichever is the lesser for vertical elements.
- 1/250 of the span between supports for horizontal elements.

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

iii. Test of Lateral Deflection per Floor Height

Lateral deflection per floor height shall be occurred on the test unit, when the structural frame

which fixes the test unit is deflected horizontally.

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

The dynamic deflection shall be applied upto + 13mm.

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

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

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

Water shall be sprinkled to the Test Unit under the wind pressure. Pressure shall not be applied to the Test Unit.

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

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

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

Install the test unit.

Hold 1st water-tightness test.

Hold test of wind pressure as described above. Hold 2nd water-tightness test. Lateral deflection test.

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

iv. **Test Report**

The Contractor is required to submit five (5) copies of test reports to the PMC/Engineer in charge.

v. **Cost of Performance Test**

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

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

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

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

vi. **Shop Drawings and Calculations for the Performance Testing**

Prior to fabrication of Test Unit, the Contractor shall submit shop drawings and calculations of the Test Unit for PMC/Engineer in charge's approval.

vii. **Record Drawings**

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

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

At completion of testing and after approval of test reports the testing laboratory shall submit the marked-up record drawings to the PMC/Engineer in charge.

viii. **Contractor's Representatives**

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

i. **Performance Guarantee**

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

Aluminium Glazing with Sliding System

1. Aluminium Sections

- Alloy: Aluminium extrusions conforming to IS 733 & IS 1285 (6063-T6 grade).
- Minimum section thickness: 2.0 mm for framing members, 2.5 mm for structural members.
- Finish: Powder coated (minimum 60–80 microns) or anodized (minimum 15 microns).
- Colour shade as approved by Architect/PMC.

2. System Type

- Sliding windows/doors with 2-track / 3-track / 4-track systems as per design.
- Smooth, noiseless sliding on nylon/steel rollers with stainless steel ball bearings.
- Profiles to include drainage arrangements for rainwater discharge.

3. Glass

- Type: Toughened glass conforming to IS 2553 (Part 1).
- Thickness: 6 mm for small windows, 8–10 mm for larger spans/sliding doors.
- For energy efficiency: Use Double Glazed Units (DGUs) with Low-E/Reflective coating, 24 mm thick (6 mm + 12 mm air gap + 6 mm).
- Edges polished and sealed with primary + secondary sealants (silicone/PU).

4. Gaskets & Sealants

- EPDM / Neoprene gaskets for weatherproofing.
- Structural silicone sealants (Dow Corning / equivalent) for glass fixing.
- Joints to be watertight and airtight.

5. Hardware & Fittings

- Sliding rollers: Heavy-duty, stainless steel ball-bearing rollers.
- Handles/locks: Aluminium powder coated or SS finish with multipoint locking system.
- Wool pile / weather strips for air infiltration control.

6. Performance Standards

- Air Infiltration: $\leq 5 \text{ m}^3/\text{hr}\cdot\text{m}^2$ at 75 Pa.
- Water Tightness: No leakage up to 300 Pa.
- Wind Resistance: To withstand design wind pressures as per IS 875 (Part 3) for Tirupati (basic wind speed 50 m/s).
- Sound Insulation: $\geq 30 \text{ dB}$ for double-glazed units.

7. Installation

- Frames anchored with SS fasteners and nylon plugs at max. 600 mm c/c.
- Proper packing and alignment to ensure plumb, level, and square positioning.
- All joints sealed with weather-grade silicone.

TECHNICAL SPECIFICATIONS FOR DRIVEWAY WORK

2.1 Scope of works

The scope of this tender covers: Driveway around the building, Kerb Stone along the driveway, pedestrian pathway around the proposed building with pavers block and cement concrete tiles (Duracrete) as per the drawings and details.

2.2 Consolidation

The sub-grade shall be consolidated with a power road roller of 8 to 12 tonnes. The roller shall run over the sub-grade till the soil is evenly and densely consolidated and behaves as elastic mass (the roller shall pass a minimum of 5 runs on the sub-grade). All undulations in the surface that develop due to rolling shall be made good with material or quarry spoils as the cases may be and the sub-grade re-rolled.

2.3 Surface Regularity

The finished surface shall be uniform and conform to the lines grades and typical cross-sections shown in the drawings. When tested with the templates and straight edge, the variation shall be within the

tolerance. Where the surface irregularity of the sub-grade falls outside the specified tolerances, the Contractor shall be liable to rectify these with fresh materials or quarry spoils as the case may be, and the sub-grade re-rolled to representative.

2.4 Sub-base/Base Courses

This shall be: round soling of size 230 mm. This shall consist of clean crushed coarse aggregate mechanically interlocked by rolling, and voids thereof filled with screening and binding material with the assistance of water, laid on a prepared sub-grade. The sub-base course shall be laid in layers not exceeding 100 mm and base course shall be laid in layers not exceeding 75 mm.

2.5 Spreading Aggregate

The soling stones shall be hand packed and shall be spread uniformly and evenly upon the prepared sub- grade in required quantities. In no case shall these be dumped in heaps directly on the area where these are not to be laid nor shall their hauling over a partly completed sub-grade be permitted. The aggregate shall be spread uniformly to proper profile by using templates placed across the road six metres apart. If desired by PMC/ BANK approved mechanical devices may be used to spread the aggregates uniformly. The levels along the longitudinal direction up to which the metal shall be laid shall be first obtained at site to the satisfaction of PMC/ BANK& these shall be adhered to. The surface of the aggregate spread shall be carefully trued up and all high or low spots remedied by removing or adding aggregate as may be require.

2.6 Rolling

Immediately following the spreading of the coarse aggregate, it shall be compacted to the full width by rolling with either a three wheel power roller of 8 to 10 tonnes capacity or an equivalent vibratory roller. Initially, light rolling is to be done, which shall be discontinued when the aggregate is partially compacted with sufficient void space in them to permit application of screenings.

The rolling shall be begun from the edges with the roller running forward and backward and adding the screenings simultaneously until the edges have been firmly compacted. The roller shall then progress gradually from the edges to the center, parallel to the center line of the road and overlapping uniformly each preceding rear wheel. Rolling shall continue until the road metal is thoroughly keyed with no creeping of metal ahead of the roller. Only slight sprinkling of water may be done during rolling, if required. On super elevated curves, the rolling shall proceed from the lower edge and progress gradually continuing towards the upper edge of the pavement.

Rolling shall not be done when the sub-grade is soft or yielding or when the rolling causes a wave like motion in the sub-base or sub-grade. When rolling develops irregularities that exceed 12 mm when tested with a three meter straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives a uniform surface shall also be checked transversely by template for camber and any irregularities corrected

in the manner described above. In no case, shall the use of screenings to make up depressions be permitted.

2.7 Sprinkling water and Rolling

After rolling the surface shall be continuously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screening into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued and additional screenings applied where necessary until the coarse aggregates are well bounded and firmly set for the entire depth and until a grout has been formed of screenings and water that will fill all voids and form a wave of grout ahead of the wheels of the Roller. The quantity of water to be used during the construction shall not be excessive so as to cause damage to the sub-base or sub-grade.

2.10 Application of Binding Material

After the rolling, river sand shall be spread and compacting by sprinkling with water

2.11 Setting and Drying

After final Compaction of the course the road shall be allowed to cure overnight. Next morning defective spots shall be filled with screenings or binding material, lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed till the macadam sets. The compacted water bound macadam course should be allowed to dry and set completely before the next pavement course is laid over it.

External Paving

The paving has to extend outside the plot and connect with the existing public road outside the two gates. This extended paving shall be outside the plot premises and shall have precast concrete kerb stone. This shall be part of the work and included in the Item rate contract .

2.23 Precast Concrete Kerbs

2.23.1 Precast Kerb Unit

The precast concrete kerbs shall be cast and installed in accordance with specifications of concrete work given in. The kerbs shall be as per details shown in the drawings and shall be of M25 mix grade (using 20 mm down coarse aggregate) specified. Wherever required so cast-in-situ special kerbs for ramps or way through hall be used, as directed by the PMC/ BANK at no extra cost.

2.23.2 Bedding and Backing

Cement concrete of 1:3:6 (using 20 mm down coarse aggregate) proportion shall be used as bedding and backing of the kerbs as shown. The concrete shall be laid, after necessary earth work to the dimensions given in the drawings and as directed by the PMC/ BANK.

2.23.3 Laying

Precast kerbs shall be laid in position in a straight line a profile as required over the bedding and then be grouted with cement sand mortar of 1:2 (1 cement: 2 coarse sand) and re-checked, its profile to the proportion drawings and finally finished smooth with 6 mm thick cement plaster 1:3 (1 cement: 3 coarse sand on exposed surfaces).

2.23.4 Laying Kerbs at Curves

Where kerbs are to be laid on curves the contractor may cast-in-situ kerbs for full length of curves of small radii and between the gaps of precast kerbs laid along the curves of greater radii as and where instructed by PMC/ BANK.

Boundary Wall

The excavation shall be done with due care with shoring and strutting of adjoining existing boundary walls and perhaps undertaking the excavation in parts in order to prevent any damage to adjoining properties.

The left right and rear boundary walls shall be plastered only on visible exposed face with vertical groove pattern of 8 to 10 mm straight grooves spaced @ 2000 mm centers (max) pressure grouting shall be done in the wall area having earth/ backfill as to prevent any water leakages and dampness etc.

2.24 Concrete Paving 2.24.1General

Paving shall be designed to suit the Unit operating requirements. In process and utilities units paving shall be provided to give sufficient access and operating space around the equipment. Paved contaminated Process Units shall be provided with trapped catch basins connected to the oily water sewer. The catch basins must be located so that the paving slopes away from process equipment and piperacks. Paving falls shall be within the limits of 1 in 30 maximum to 1 in 120 minimum. In process units the paving may be sloped towards the unit limits to drain to channels.

SECTION – VI TECHNICAL SPECIFICATION OF PLUMBING WORKS:

1.0. Technical Specification of DSR items of Public health works (Based on DSR 2023/ BANK SOR) 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).

2.0 For Nonscheduled item mentioned in SOQ shall be installed as per manufacturer's direction approved by the PMC/ BANK.

3.0 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 PMC/ BANK. 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, Flushing water supply through gravity pressure 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.

2.4 Garden Hydrant system with Drip irrigation

2.5 External water supply 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, flushing & irrigation water requirement shall be met 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 conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the PMC/ BANK. All materials and/or Workmanship which in the opinion of the PMC/ BANK 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 conform to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the PMC/ BANK.

As and when required by the PMC/ BANK, 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 PMC/ BANK, 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 PMC/ BANK. 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 (Domestic, Flushing & Garden Irrigation System).
- iv) Sewerage & Storm water drainage system
- v) Water Supply 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 Engineer In charge . All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

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 PMC all discrepancies or deviations noticed. The decision of the PMC 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 tender drawing issued by the PMC for the work are the property of the PMC and shall not be lent, reproduced or used on any works other than intended without the written permission of the PMC

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 PMC.
- 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 Engineer In charge 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 Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.
- 1.7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings submitted by the contractor & after approval by Bank / PMC, work executed by the contractor.
- 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 PMC or Architects.
- 1.9 **Shop Drawings**
- 1.9.1 The Contractor shall submit to the PMC 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 PMC.
- 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 PMC. 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 PMC.

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 PMC. 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 PMC/ 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 Engineer In Charge. 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 PMC.

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 PMC.

1.19 **Materials**

1.19.1 Unless otherwise specified and expressly approved in writing by the PMC, 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 PMC and returned to the Contractor at the appropriate time.

SECTION II: SANITARY FIXTURES**2. SANITARY FIXTURES****2.1 Scope of Work**

2.1.1 Work under this section shall consist of furnishing all materials and labour as necessary and required to completely install all Sanitary Fixtures, chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

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

- a) Sanitary fixtures
- b) Chromium plated fittings
- c) Porcelain or stainless-steel sinks
- d) Accessories e.g. towel rods, toilet paper holders, soap dish, towel rack, coat hooks etc.
- e) Mirrors
- f) Connections to all kitchen equipment's pump headers and other equipment requiring water and drainage connections.

2.1.3 Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

2.1.4 All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2.2 General Requirements

2.2.1 Sanitary fixtures shall be of best quality approved by the PMC. Wherever particular makes are mentioned, the choice of selection shall remain with the PMC. All faucets and cisterns shall have a discharge rate as made mandatory by BEE 5 star rating. The contractor shall comply BEE 5 star rating given in specifications & BOQ prior to final purchase of the items.

2.2.2 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces.

2.2.3 Fixing screws shall be half round head Chromium Plated brass screws with C.P. washers where necessary.

2.2.4 Contractor shall furnish without cost of all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures and C.P fittings by the manufactures as a part of the original standard supply.

2.2.5 All Fittings and Fixtures shall be fixed in a neat workmanlike manner true to levels and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all Inlet and Outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractors cost.

2.2.6 Contractor seal fixtures fixed near wall, marble and edges. With an approved type of poly-sulphide sealant appropriate for its application.

2.3 **Supply of Fixtures & Fittings by the Contractor**

2.3.1 All Porcelain fittings, C.P fittings and accessories shall be supplied by the Contractor.

2.3.2 Contractor shall take the delivery of the materials directly from the suppliers and will be responsible for its safe storage and custody in the godown as provided by the owner.

2.3.3 Only materials, accessories and fixing devices supplied as standard supplies by the manufacturer shall be given to the Contractor free of cost at site.

2.3.4 All balance materials e.g. nuts, bolts, CP nuts and bolts; other fixing devices shall be supplied by the Contractor within the quoted rates.

2.3.5 Description and method of fixing is given below for the contractor to understand the scope and extent of the work for which main materials will be supplied by the Bank.

2.4 **Wall Mounted European W.C**

2.4.1 European W.C. shall be wash down or syphonic type floor or wall mounted set flushed by means of porcelain flushing cistern, exposed type flush valve or by imported type plastic flushing systems which will be an integral part of the wall system. **Framework, walling and finishing will not form a part of the Contractor's work.** Where ever applicable flush pipe/bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by a floor mounted chair.

2.4.4 Flushing cistern (exposed/coupled/concealed/others) when provided shall be provided with all internal flushing mechanism, 15mm dia ball cock with unbreakable polyethylene float and overflow pipe. Any frame work required for fixing cistern has to be provided by the Contractor. Each W.C shall be suitable for flushing in low volume of water 5-6 liters.

2.5 **Sensor based Urinals**

2.5.1 Sensor based Urinals shall be white glazed Vitreous China of size, shape and type specified in the Schedule of Quantities.

2.5.2 Urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete as directed by PMC/ Bank.

2.5.3 Flush pipe shall be uPVC pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities.

- 2.5.4 Urinals shall be flushed by fully automatically no-touch flush valve with solenoid valves.
- 2.5.6 Waste pipes for urinals shall be uPVC 6 kg/cm² as per IS 4985. Waste pipes may be exposed on wall or concealed in chase as directed by the Specifications for waste pipes shall be same as given in Section 3.

2.6 **Wash Basin**

- 2.6.1 Wash basins shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.
- 2.6.2 Each Basin shall be provided with brackets and clips of approved and securely fixed. Placing of Basins over the brackets without secure fixing shall not be accepted.
- 2.6.3 Each Basin shall be provided with a 32mm dia waste with overflow, pop-up waste or rubber plug and chain as specified in the Schedule of Quantities, 32mm dia PP bottle trap with built-in AAV & pipe to wall and flange.
- 2.6.4 Each basin shall be provided with mixing fitting as specified in the Schedule of Quantities.
- 2.6.5 Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by PMC/ Bank.

2.7 **Sinks**

- 2.7.1 Sinks shall be stainless steel or any other material as specified in the Schedule of Quantities.
- 2.7.2 Each sink shall be provided with brackets of approved and securely fixed. Counter top sinks shall be fixed with suitable brackets or clips as recommended by the manufacturer. Each sink shall be provided with 40 mm dia C.P. waste with chain and plug as given in the Schedule of Quantities. Fixing shall be done as directed by PMC/ Bank.
- 2.7.3 Supply fittings for sinks shall be mixing fittings or C.P. taps as specified in the Schedule of Quantities.

2.8 **Accessories**

- 2.8.1 Contractor shall install all Chromium Plated and porcelain accessories as shown on the drawings or directed by PMC/ Bank.
- 2.8.2 All C.P. Accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by PMC/ Bank.
- 2.8.3 Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Interior Designer's drawings.

2.9 **Liquid Soap Container**

- 2.9.1 Liquid Soap Container shall be of approved quality.

2.10 Towel Ring

2.10.1 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

2.11 Coat Hook

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

2.12 WC Pan Connector

2.12.1 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

2.13 Sink Mixer

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

2.14 Water cooler

2.14.1 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

2.15 Two way bib cock

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

2.16 Health faucet

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

2.17 Towel rail

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

2.18 Soap Dish Holder

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

2.19 Handicap Toilet

2.19.1 Handicap toilet with 600mm wide grab bar with European WC and and Wash basin

2.20 Measurement

2.20.1 Sanitary fixtures and accessories shall be measured by numbers in the unit given in the Schedule of Quantities.

2.20.2 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. Water connection will be taken from the existing water supply network across the campus.
- b. Flushing Water Main Distribution System from S.T.P. to U.G.T.
- c. Transfer pumps set shall be considered for filling of domestic and flushing overhead water tank.
- d. Level sensor-based solenoid valve will be installed at terrace level in domestic and flushing water tank for automatic operation of water pump set for tank filling purpose. Electronic sensor-based water level indicator is considered for OHT to monitor water level in the tanks.
- e. Once the Water level in OHT decreases and reaches at desired Low level then domestic and flushing transfer pump will come in operation automatically and start filling the OHT and after reaching the Maximum set level in OHT the transfer Pump will stop.
- f. Pipe protection and painting.
- g. Providing insulation to hot & cold-water pipelines wherever required.
- h. Connections to all plumbing fixtures, kitchen equipment, tanks, appliances, irrigation features.
- i. Ball valve/butterfly valve/non-Return valve/Float valve/Pressure relief valve/Air valve, masonry chambers & other appurtenances.
- j. Supports/ Clamps, Excavation& refilling of pipe trenches, required civil work. Water meters, gauges, etc. required.

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 PMC/ Bank.

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 CPVC pipes, fittings & valves

3.3.1 All pipes inside the toilet and where specified, outside the building shall be CPVC pipes tubes conforming to IS 15778:1996. Specific Gravity ASTM D 792 at 23oC should be 1.55 as

specified. With Tensile Strength as per ASTM D 638 at 23oC should be 55N/mm2.

3.3.2 **JOINING PIPE & FITTINGS**

a. **Cutting**

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

b. **Deburring/ Beveling**

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

c. **Fitting Preparation**

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

d. **Solvent Cement Application**

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

e. **Assembly**

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

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

Set & Cure times:

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

Minimum Core prior to pressure testing at 150 psi

S.no	Ambient Temperature during Core period	Pipe Size	
		½" to 1"	1.¼" to 2"
1	Above 15 deg C	1 Hr	2 Hrs
2	4 – 15 deg C	2 Hrs	4 Hrs
3	Below 4 deg C	4 Hrs	8 Hrs

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

3.3.2 **Transition of CPVC to Metals**

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

3.3.3 **Threaded Sealants**

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

3.3.4 **Hangers & Supports**

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

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

Support should be as per the below mentioned table:

S.No	Size of Pipe	21°C	49°C	71°C	82°C
	Inch	Ft	Ft	Ft	Ft
1	½"	5.5	4.5	3.0	2.5
2	¾"	5.5	5.0	3.0	2.5
3	1"	6.0	5.5	3.5	3.0
4	1 ¼"	6.5	6.0	3.5	3.5
5	1 ½"	7.0	6.0	3.5	3.5
6	2"	7.0	6.5	4.0	3.5

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

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

3.3.7 Concealed Plumbing:

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

3.4 **uPVC pipes, fittings & valves**

3.3.1 All pipes exposed in terrace and shaft and where specified, outside the building shall be uPVC pipes tubes conforming to IS 4985.

3.3.2 **JOINING PIPE & FITTINGS**

a. **Cutting**

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

b. Deburring/ Beveling

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

c. Fitting Preparation

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

d. Solvent Cement Application

Only uPVC solvent cement should be used for joining pipe with fittings. uPVC schedule 40 solvent cement only should be used.

e. Assembly

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

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

Set & Cure times:

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

Minimum Cure prior to pressure testing at 150 psi

S.no	Ambient Temperature during Core period	Pipe Size	
		½" to 1"	1.1/4" to 2"
1	Above 15 deg C	1 Hr	2 Hrs
2	4 – 15 deg C	2 Hrs	4 Hrs
3	Below 4 deg C	4 Hrs	8 Hrs

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

3.3.2 Transition of uPVC to Metals

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

3.3.3 Threaded Sealants

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

3.3.4 Hangers & Supports

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

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

Support should be as per the below mentioned table:

S.No	Size of Pipe	21°C	49°C	71°C	82°C
	Inch	Ft	Ft	Ft	Ft
1	½"	5.5	4.5	3.0	2.5
2	¾"	5.5	5.0	3.0	2.5
3	1"	6.0	5.5	3.5	3.0
4	1 ¼"	6.5	6.0	3.5	3.5
5	1 ½"	7.0	6.0	3.5	3.5
6	2"	7.0	6.5	4.0	3.5

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

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

3.5 Water Supply System

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

3.5.2 Source
Water supply will be acquired from master line and collected in under ground water storage tanks.

3.6 **Pipe Supports**

3.6.1 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.

3.6.2 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.

3.6.3 **Clamps**

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by PMC. 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.

3.7 **Anchor Fasteners**

3.7.1 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.

3.8 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 PMC.

3.9 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.

3.10 Valves

3.10.1 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.

3.11 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.

3.12 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

1.1 Work under this section shall consist of furnishing all labour, materials, equipment's 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. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install for Drainage system (Sewage & Storm water) as required by the drawings, specified hereinafter and given in the Schedule of Quantities.
- b. Without restricting to the generality of the foregoing, the drainage system shall include the following: -
- c. All soil/ waste water & rain water lines to various parts of the building including connection to vertical stack & to final disposal point which maybe city sewer / storm manhole / Nalla / Sewage or Effluent Treatment Plant.
- d. Pipe slopes/ gradient to achieve self-cleansing velocity.
- e. Drain Connections to all plumbing fixtures, Floor drains, equipment, tanks, appliances, irrigation features, water bodies.
- f. Supports/ Clamps, Excavation & refilling of pipe trenches, required civil work.

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 Engineer In charge.
- 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

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.

- a) Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement floor ceiling as shown on the drawings.
- b) All Floors of toilets, kitchens and other service areas located on structural slab are SUNK by 125 mm to accommodate waste pipes of 40mm, 50mm & 63mm.
- c) All soil and waste from areas below general ground level will be collected in sumps and pumped into sewer lines.

- d) 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 PMC/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 1m.
- 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 PMC.
- 4.6.7 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

SYSTEM PERFORMANCE GUARANTEE

- a. The Contractor shall guarantee that upon completion of work, all installed systems thereof shall be in full accordance with the requirements of the contract and shall be perfect as to materials and workmanship and shall remain as per contract agreement.
- b. Contractor shall submit charts / performance curves for selected equipment with the operating points duly marked on them. If during the shop test it is found that the equipment does not meet specification, any modification/ replacements of any part or equipment as a whole are required, the same shall be done by the Contractor at no extra cost to the PMC/ Bank.

MARKINGS:

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

PIPES & FITTINGS:

Soil & Waste Pipes & fittings shall be as per IS 15392 Type-B

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 where ever 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 PMC. 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 uPVC Pipes 6 kg/sqcm confirming to IS 4985.

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

SECTION V Rainwater Pipes & Fittings**5.1 Scope of work**

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

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

- a) Vertical and horizontal rain water pipes, and fittings, joints, clamps and connections to fixtures.
- b) Connection of all pipes to storm lines as shown on the drawings.
- c) Testing of all pipe lines.

5.3 General requirements

5.3.1 All materials shall be new and best quality conforming to Latest IS Code and specifications and subject to the approval of the Engineer In charge.

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

5.3.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

5.3.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps an interval specified.

5.3.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

5.4 Piping System**5.4.1 Rainwater Pipes**

- a) All terraces shall be drained by providing down-takes rainwater pipes.
- b) A separate piped drainage system for slopping roof with leaders shall be provided.
- c) Rainwater pipes are separate and independent connected to the external storm water drainage system as shown on the drawings.

5.4.2 Balcony/Planter drainage

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

5.5 uPVC pipes for SWR Type- A system

5.5.1 Pipes

5.5.1.1 All pipes shall be straight and smooth and inside free from cracks and other manufacturing defects. Pipes shall be conforming to IS: 13952 type A for rain water.

5.5.1.2 Pipes shall be joined by approved type of socket and 'O' rubber ring (confirms to IS: 5382) joints with rubber lubricant.

5.6. Fittings

5.6.1 Fittings shall conform to the Indian Standard recommended for the pipes. Pipes and fittings must be of matching IS specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

5.6.2 Fittings shall be of the required degree of curvature with or without access door.

5.6.3 Connection from a vertical stack or position to a horizontal line shall be made only by a "Y" junction.

5.7 Fixing

5.7.1 All vertical pipes shall be fixed truly vertical to walls with approved type of uPVC saddle clamp. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard). However shaft where more vertical pipes run, the pipes may be fixed to the slotted angle/channel supports fixed to walls at intervals specified here under:-

5.7.2 Horizontal pipes running along ceiling shall be fixed on **galvanized structural adjustable clamps** (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

5.7.3 Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the PMC/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.

5.8 Clamps

5.8.1 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.

5.8.2 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.

5.8.3 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.

5.8.4 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.

- 5.8.5 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.
- 5.8.6 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 PMC/ Bank.
- 5.9 For sleeves, anchor fasteners and clamp spacing chart shall be as follows:

CLAMP AND PIPE SUPPORT SPACING

S.No.	Type of Pipes & Position	Commercial Pipe Dia. (Spacing in m)						
		15/20	20/25	32/40	50	75/80	100/110	150/160
1	Vertical Pipes							
1.1	GI /MS Pipes	2.4	2.4	3		3.6	4.5	5.4
1.2	uPVC Pipes SWR Pipes IS 13592	x	x	<----- 1 m ----->				
1.3	uPVC /cPVC Pipes IS 4985 for Water Supply	x	x	x	<----- 1 m ----->			
	IS 13585 for SWR	x	x	0.5		0.7	0.9	0.9
2	Horizontal Pipes							
2.1	GI /MS Pipes	<-----2.0 m----->		2.4 m	3	3.6	4	4.5
2.2	uPVC pipes SWR Pipes IS	<----- 1.0 m ----->						
	Water Supply Pipes uPVC IS 4985						<----- 1 m ----->	
2.3	Fittings	All traps and tees and fittings running below ceiling shall be supported on both sides						

5.10 Cutting and making good

- 5.10.1 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.

5.11 Testing

- 5.11.1 Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid along basement ceiling.
- 5.11.2 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.

5.11.3 All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site.

5.11.4 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.

5.11.5 Contractor shall maintain a test register identifying date and time of each area. All tests shall be conducted in presence of PMC and signed by both.

5.12 Measurements

5.12.1 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 centimetre)

5.12.2 Pipes shall be measured per running meter correct to a centimetre 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.

5.12.3 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.

5.12.4 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.

5.13 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.

5.14 Excavation for rain water 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.

5.15 PMC's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.**SECTION VI: EXTERNAL WATER SUPPLY SYSTEM****6. EXTERNAL WATER SUPPLY SYSTEM (DOMESTIC, FLUSHING, IRRIGATION)****6.1 Scope of Work**

6.1.1 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.

6.1.2 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 master water supply line underground water tanks.
- c) Excavation and refilling of pipes trenches.
- d) Pipe protection and painting.
- e) Control valves, masonry chambers and other appurtenances.
- f) Connections to all plumbing fixtures, tanks, appliances and Municipal mains

6.2 General Requirements

6.2.1 All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the PMC/ Bank.

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

6.2.3 Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections.

6.2.4 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.

- 6.2.5 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 6.2.6 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.
- 6.2.7 All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.
- 6.2.8 Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

6.3 **Water Supply System**

- 6.3.1 Contractor should study the site plan and water supply system diagram for an overview of the system.
- 6.3.2 Source
Water supply will be acquired from master water mains to water storage tanks located in basement.

6.4 **GI pipes, fittings & valves**

- 6.4.1 Domestic & Flushing water supply from the master water supply line to Underground tank shall be GI C Class Heavy duty pipe confirming to IS 1239

6.5 **JOINING PIPE & FITTINGS**

GI Pipe 50mm and below shall be threaded joint and above 50mm shall be welded joint.

6.6 **PAINTING PIPE & FITTINGS**

GI Pipe shall be paint with two coats of anti-corrosive bitumastic paint

6.7 **Trenches**

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows

<u>Dia of pipe</u>	<u>Width of Trench</u>	<u>Depth of Trench</u>
15mm to 50mm	30 cms	75cms
65mm to 100mm	45 cms	100 cms

6.8 **Sand filling**

Pipes in trenches shall be protected with fine sand 15 cms thickness all round before filling in the trenches.

6.9 **Painting**

- 6.9.1 All pipes above ground shall be painted with one coat of red lead and two or more coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code given in this document or specified by PMC/ Bank.

6.10 **Pipe protection**

6.10.1 All GI pipes in wall chase and below floor in toilets (where so fixed) shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

6.10.2 G.I. water supply pipes, if buried in ground or sunken slab, shall be protected with multi-layer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. "Pypkote" or equivalent.

6.11 Valves

6.11.1 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 20 kg, sq.cm., and accompanying couplings and steel handles. (to BS 5351)

6.12 Butterfly Valves – Slim Seal Type

6.12.1 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.

6.12.2 Butterfly valve shall be of best quality conforming to IS: 13095.

6.13 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.

6.14 Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities, further connections and accessories shall be provided under this contract.

6.15 Testing

All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm whichever is more. Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and PMC.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes' or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defect's liability period without any cost.

After commissioning of the water supply system, Contractor shall test each valve by closing

and opening it a number of times to observe if it is working efficiently. Valves, which do not effectively operate, shall be replaced by new ones at no extra cost and the same shall be tested as above.

Hot water pipes chased into the walls shall be provided with a 6mm thick insulation with elastic flexible material having hermetic closed cell structure of expanded synthetic material rated for 60°C hot water supply.

6.15 All the irrigation Pipe shall be HDPE PE-100 PN-8 Pipe

6.16 Measurement

- a) Pipes above ground shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, flanges and U clamps with nuts, bolts & washers fixed to wall or other standard supports.
- b) Jointing with teflon tape, white lead, solvent, crimping and insertion gasket of appropriate temperature grade.
- c) Cutting holes, and chases in walls, floors, any pipe support required for pipes below ground & making good the same.
- d) Excavation, backfilling, disposal of surplus earth and restoring the ground & floor in original condition.

6.17 Pipe Supports

Fabricated and / or galvanised supports shall be measured by weight. Weight for each type of clamp shall be calculated on basis of the quantity of structurals and MS used from the theoretical weight calculated on basis of the components theoretical weight of the sections.

6.18 Rate quoted for supports & hangers shall be inclusive of :

- a) Expandable anchor fastens.
- b) Galvanising of all supports & hangers.
- c) Cutting holes in walls, ceilings on floors and making good where permitted.
- d) Nuts, bolts and washers for fixing and assembling.
- e) Wooden / PVC pipe saddles for vertical or horizontal runs.

6.18.1 Valves

Gunmetal, cast iron, butterfly and non-return valves and puddle flanges shall measured by numbers and shall include wheels I caps, GI nuts, bolts, washers, insertion gasket.

6.18.2 Painting/pipe protection/insulation

Painting/pipe protection /insulation for pipes shall be measured per linear meter over finished surface and shall include all valves and fittings for which no deduction shall be made. No extra payment shall be made for fittings, valves or flanges.

6.19 Irrigation system

Irrigation is by the drip irrigation system with HDPE Pipe

6.20 Water meter

Water meter shall be digital type water meter.

SECTION VII: SEWAGE & STORM WATER WORK

7.1 Scope of work

- 7.1.1 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.
- 7.1.2 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.

7.2 General requirements

- 7.2.2 All materials shall be new of the best quality conforming to specifications and subject to the approval of the PMC/ Bank.
- 7.2.3 Drainage lines and open drains shall be laid to the required gradients and profiles.
- 7.2.4 All drainage work shall be done in accordance with the local municipal bye-laws.
- 7.2.5 Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.
- 7.2.6 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 PMC/ Bank.

7.3 Excavation

7.3.2 Alignment and grade

The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the PMC. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the PMC/ Bank.

7.3.3 Excavation in tunnels

The excavation for sewer works shall be open cutting only, unless the permission of the PMC/ Bank is obtained for laying pipes in tunnel where sewers have to be constructed along narrow passages or difficult ground.

7.3.4 Opening out trenches

In excavating the trenches, etc. the solid road metalling, pavement, kerbing, etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the PMC/ Bank.

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

7.3.5 Obstruction of roads

The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the PMC/ Bank.

7.3.6 Removal of filth

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

7.3.7 Excavation to be taken to proper depths

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating thereto and so that the inverts may be at the levels given in the sections.

7.3.8 Refilling

After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the

sewer and other permanent work. The filling in the haunches and upto 75cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15cms layers with materials taken from the excavation, each layer is being watered to assist in the consolidation unless the PMC/ Bank.

7.3.9 Contractor to restore settlement and damages

The contractor shall, at his own costs and charges make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also at his own cost and expenses and charges, repair any make of any damage done to the buildings and other property.

7.3.10 Disposal of Surplus Earth

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

7.3.11 Timbering of sewer and trenches

- a) The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose of sandy strata and below the surface of the sub soil water level.
- b) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall be take place.
- c) The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

7.3.12 Shoring of Buildings

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

7.3.14 Removal of water from sewer, trench etc

- a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.
- b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses.

7.3.15 Width of trench

7.3.16 Recommended width of trenches at the bottom shall be as follows:-

100 mm dia pipe	55 cms
150 mm dia pipe	55 cms
225-250 mm dia pipe	60 cms
300 mm dia pipe	75 cms

Maximum width of the bed concrete shall also be as above. No additional payment is admissible for widths greater than specified.

7.3.17 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 PMC. 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.

7.4 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 PMC/ Bank. A test register shall be maintained which shall be signed and dated by Contractor.

7.5 Gully traps

Gully traps shall be of the same quality as described for stoneware pipes in clause 5.4.1 above and used where shown on drawings.

Gully traps shall be fixed in cement concrete 1:5:10 mix (1 cement: 5 coarse sand: 10 stone aggregate 40 mm nominal size) and a brick masonry chamber 30x30 cms inside plastered with cement mortar 1:5 with 15x 15 cms grating inside and 30x30 cms C.I. sealed cover and frame weighing not less than 7.3 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size.

7.6 DWC pipes

- All underground storm water drainage pipes and sewer lines where

specified double layer pipe with the outer layer having corrugation and the inner layer with a smooth surface. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

- **Laying**

DWC pipes shall be laid on cement concrete bed or without concrete as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the PMC/ Bank.

- **Jointing**

- The jointing procedure of DWC pipes is easy and simple to adopt and is illustrated below.



- **Testing**

All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above. The smoke test shall be carried out by the contractor, if directed by the PMC and a test register shall be maintained which shall be signed and dated by the Contractor/PMC.

7.7 Cement Concrete and masonry works (For Manholes and Chambers)

7.7.1 Materials

a) Water

Water used for all the construction purposes shall be clear and free from Oil, Acid, Alkali, Organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for construction purpose.

b) Aggregate for Concrete

The aggregate for concrete shall be in accordance with I.S. 383 and I.S. 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of PMC/ Bank. The size of the coarse aggregate shall be done as per I.S.383.

c) Sand

Sand for various constructional purposes shall comply in all respects with I.S 650 and I.S. 2116. It shall be clean, coarse hard and strong, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the PMC/ Bank.

d) Cement

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I.S. 269.

e) Mild Steel Reinforcement

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I.S. 432 (Grade I).

f) Bricks

Bricks shall have uniform color, thoroughly burnt but not over burnt, shall have plan rectangular faces with parallel sides and sharp right-angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the PMC/ Bank.

g) Other Materials

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be

approved by the PMC/ Bank before use.

7.7.2 Cement concrete (plain or reinforced)

- a) Cement concrete pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.
- b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.
- c) All concrete work shall be cured for a period or at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during the curing period.

7.7.3 Masonry

Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Schedule of quantities in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

7.7.4 Cement concrete for pipe support

Wherever specified or shown on the drawing, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be as per para 5.3.1.4.

Unless otherwise directed by the Project Engineer, cement concrete for bed, all-round or in haunches shall be laid as follows: -

	upto 1.5 m depth	upto 3 m depth	beyond 3 m depth
dwc pipes In open ground (no sub soil water)	All round (1:4:8)	(1:4:8)	Haunches All round (1:4:8)
R.C.C (In sub soil water)	All round (1:3:6)	(1:3:6)	Haunches Haunches (1:3:6)
PP Pipes (In all conditions)	All round (1:3:6)	Haunches (1:3:6)	Haunches (1:3:6)
R.C.C Pipes Or PP Pipes Under or building	All round (1:3:6)	All round (1:3:6)	All round (1:3:6)
(Ratio refer to cement: coarse sand: stone aggregate 40 mm nominal size)			

R.C.C pipes or DWC pipes may be supported on brick masonry or precast R.C.C or in situ cradles. Cradles shall be shown on the drawings. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7.8 Manholes and chambers

7.8.1 All manholes, chambers and other such works as specified shall be constructed on brick masonry in cement mortar 1:5(1 cement: 5 coarse sand) as specified in the Schedule of Quantities.

7.8.2 All manholes and chambers, etc. shall be supported on base of cement concrete of such thickness and mix as given in the Schedule or Quantities or shown in the drawings.

Where not specified, manholes shall be constructed as follows:- (all dimensions internal clear in cms)

Size of manhole type	90x80 Rect.	120x90 Rect.	91 dia Conical	122 dia Conical
Maximum depth	120	240	167	168
Average thickness Of R.C.C slab	15	15	-	-
Size of cover and frame cms	60x45	50 dia	50 dia	50 dia
Weight of Cover and frame	38 kg	116 or 208 kg	116 or 208 kg	116 or 208 kg

7.8.3 All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nom. Size) as per standard details.

7.8.4 All manholes shall be plastered with 12mm thick cement mortar 1: 3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster mixed with water proofing compound.

7.8.5 All manholes with depths greater than 1 m. shall be provided with 20 mm square or 25 mm round rods plastic coated catch rings set in cement concrete blocks 25x10x10 cms in 1:2:4 mix 30 cms vertically and staggered. Foot rests shall be coated with coal

tar before embedding.

7.8.6 All manholes shall be provided with cast iron/steel fiber reinforced plastic (SFRC) covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.

7.8.7 Road gullies, ramp drains, gratings in basement shall be cast iron with M.S. frame or Steel Fiber Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities.

7.9 Making connections

7.9.1 Contractor shall connect the sewer line of the building to the main manhole by providing making holes and channels etc.

7.10 Measurement

7.10.1 Excavation

Measurement for excavation of pipe trenches shall be made per linear meter under the respective category of soil classification encountered at site and specified in the tender.

- A) Ordinary soil
- B) Hard soil (hard moorum & soft rock)
- C) Hard rock requiring chiseling
- D) Hard rock requiring blasting

Trenches shall be measured between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth up to 1.5 m or as given in the Schedule of Quantities.

Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the schedule of quantities and above the rate for depth up to 1.5 m.

Timbering and Shoring Timbering and shoring as described above shall be measured per sq m and paid for as per the type of timbering or shoring done at site and as per the relevant item in the Schedule of Quantities. Rate for timbering and shoring shall be for all depths and types of soil classifications including saturated soil.

Saturated Soil

No extra payment for pumping and bailing out water shall be made for excavation with an average depth of 1.5 m in saturated soil, surface water from rain falls or broken pipes lines, or sieves and other similar sources. An extra rate as quoted in the schedule of quantities shall be paid for excavation in saturated soil for pipe trenches above average depth of 1.5 m. No payment is admissible for water collected from surface sources and broken pipelines or sewers.

Refilling, Consolidation and Disposal of Surplus Earth

Rate quoted for excavation of trenches shall be inclusive of refilling, consolidation and disposal of surplus earth within a lead of 1500 m.

7.10.2 DWC Pipes / RCC pipes

DWC /R.C.C. pipes shall be measured for the finished length of the Pipe line per linear meter i.e.

- (a) Lengths between manholes shall be recorded from inside of one manhole to inside of other manhole
- (b) Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole. Rate shall include all items given in the schedule of quantities and specifications.

7.10.3 Gully Traps

Gully traps shall be measured by the number and rate shall include all excavation, foundation, concrete brick masonry, cement plaster inside and outside, C.I. grating and sealed cover and frame.

7.10.4 Cement Concrete for Pipes

Cement concrete in bed and all round or in haunches shall be paid per running meter between the outside walls of manholes at bottom of the trench. No additional payment is admissible in

respect of concreting done for widths greater than specified, for shuttering or centering and concreting in sub soil water conditions.

7.10.5 Manholes, Catch basins & Ramp drains

- a) All manholes and catch basins shall be measured by numbers and shall include all items specified above and necessary excavation, refilling & disposal of surplus earth.
- b) Manholes with depths greater than specified under the main item shall be paid for under "extra depth" and shall include all items as given for manholes. Measurement shall be done to the nearest cm. Depth of the manholes shall be measured from top of the manhole cover to bottom of channel.
- a) Ramp drains shall be measured per meter length.

7.10.6 Making Connections

Item for making connection to municipal sewer shall be paid for by number and shall include all items given in the Schedule of Quantities and specifications.

END OF SECTION VII

SECTION VIII: WATER COOLER

Water cooler with Inbuilt RO purification + UV(50LPH) .Cooling capacity shall be 60 liter & 80 liter shall be storage capacity. It's 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 IX 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) Motor control panels, power and control cabling and allied electrical works.

b) 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.

8.3.9 RANSFER PUMP SYSTEM FOR OHT FILLING

This system shall consist of SS vertical multistage centrifugal pump. Each pump shall have TEFC 2900 RPM three phase electric motor. The pump shall have, SS casing, cast Iron head, SS base, SS Shaft/ Impeller/ Intermediate chamber.

Pump shall be provided with cartridge type mechanical seal. The pump shall

be suitable for auto/ manual operation.

The system shall be with Skid mounted, wall mounted / floor mounted electrical control panel comprising of Control cabinet with an IP 54 enclosure of suitable rating with the keypad and pressure display screen mounted through the outer door. In addition to the electronic pump controller, the control cabinet shall include pressure transmitter, float switches, circuit breakers for each pump and the control circuit, control relays for alarm functions and fuses.

Section - VII**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 PMC/ Bank. 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 PMC/ Bank as applicable.

SI 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/ AKG
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	Supreme/ Ashirwad/ Astral/ AKG
13	CPVC Pipes & Fittings	Supreme / Ashirwad/ Astral/ AKG
14	Stainless Steel Grating	Jayna/ Neer / Chilly
15	CI Pipes	Neco/ Hepco/ SKF
16	Channel Grating	Jayna/ Neer / Chilly
17	uPVC Floor Trap	Supreme / Ashirwad/ Astral/ AKG
18	uPVC Floor Drain	Supreme / Ashirwad/ Astral/ AKG

19	uPVC Multi Trap	Supreme / Ashirwad/ Astral/ AKG
20	Air Release Valve	Sant / Zoloto/ Lehry
21	SW Gully Trap	Anand
22	SS Pipe	Jindal/ VSH/ Tata
23	GI Pipes as per IS:1239	Surya Prakash/ Jindal hissar/ Tata/ APL Apollo
24	GI Fittings (Malleable Cast Iron) as per IS:1879	Zoloto / Sant/ Surya Prakash
25	Cables	Polycab/ Sky tone / Finolex
26	RCC Pipes	Om spun Pipes/ Indian Hume Pipe/ Jain Spun pipes/ Shri Balaji Spun Pipe
26	HDPE DWC Pipe	Astral/ Prince/ Supreme
27	S.F.R.C. Manhole covers	Om Spun pipe/ KK Manhole / BRHC
28	CI Manhole covers	NECO / KK / Bengal Iron Corporation/ SAH
29	Ductile Iron pipe	Jindal Saw Ltd/ Electro steel/ Tata
30	DI Fittings	Electro steel/ Kejriwal/ Jai Balaji (Supra)
31	PVC encapsulated Foot rest	KK Manhole / KGM / Bentex
32	Pumps	Xylem / Lubi / Ground foss
33	Heat Pump	AO Smith/ benchmark/ Suntec
34	Filter & Softener	Pentair/ Ion exchange/ Thermax
35	Chemical Dosing Pumps/Tanks	Toshcon/ ASIA LMI/Edose
36	Level Controller / Lvel Sensor	AIP /Danfoss / Flow line
37	Pressure Gauge	H Guru/ Fiebig/ Emerald
38	Strainer	Sant / Zoloto/ Lehry
39	Pressure Switch	L&T/ Johnson/ Honeywell
40	Fire Sealant/ Fire Reterdant paint	3M/ Hilti/ Powers
41	Pipe Support & Clamps	Chilly/ Euroclamp/ Easyflex
42	Pipe Hangers	Gripple/ Hitech/ Om Fasteners
43	Paints	Asian paints/ Berger / Shalimar Paints

44	Welding rods & Electrodes	Ador/ Cosmos/ Prima (S)
45	Fastener	Fisher/ Hilti/ Mungo
46	Vibration Eliminator	Resistoflox, Noida/ Dwren - Calcutta
47	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 pane /risha Control

ELECTRICAL WORKS

**(ESS SUBSTATION, EXTERNAL STREET &
FAÇADE LIGHTING, SOLAR POWER PLANT, ESE
LIGHTNING ARRESTER, ELEVATORS, DG SETS
ETC.)**

SPECIAL CONDITIONS

1. SCOPE OF WORK

The scope of work to be carried out under this contract is mentioned in drawings, specifications and schedule of quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's representative. Work under this contract consist of furnishing all materials and labour equipment, except those to be supplied at site directly by the Owner as listed under Schedule of Quantities and specified otherwise including transportation, installation, testing and commissioning of the complete Electrical system as described in the technical specifications and as shown on the drawings. The Electrical system in this contract consists of following items of works:

1.1 ESS Sub Station & External Electrical Installation

- i. 11 kV / 0.433 KV receiving ESS Sub-Stations comprising of but not limited to following :
 - a. 11 kV VCB HT Panel with Battery Charger, UPS etc.
 - b. Space & Metering panel, RMU etc. room provision as per NDMC requirement.
 - c. Oil Type Transformers with OLTC & RTCC Panels
 - d. Sandwich Bus Ducts from Transformers to LT Panel, LT LBS.
 - e. All Associated Equipment & accessories required
- ii. independent 11 kV underground interconnecting cable from Ring Main System to 11 kV ESS Substations.
- iii. DG Sets with AMF Panel and Manual Change over switch for Switching between Two DG Sets with all accessories etc.
- iv. Lightning Protection System & Earthing Network
- v. 11 kV HT Power Cables, 1.1 kV LT power cables in the Sub Station.
- vi. Solar & Conventional (Hybrid) Street Light System.
- vii. Façade Illumination / Lighting.
- viii. Solar Power Plant (On grid).

The Electrical distribution should include the following system also need to be considered for IGBC Platinum & Net Zero Building Certification (Energy) to be provided by EPC agency.

All Exterior lighting shall be controlled by photo sensor or astronomical time switch. Exit signs shall not exceed 5W per face.

2. CIVIL WORKS RELATED TO ELECTRICAL INSTALLATION

Following civil works associated with related Electrical installation are in the scope of this contract. These shall be executed by in accordance with approved drawings.

- RCC foundation for all Substation equipment including Transformers, CT PT Unit, with angle iron frame (properly painted with fire retardant paint) at the edges to protect these from damage.

- RCC Trenches inside Sub-station and LT panel room including cable supports for lying of LT cables.
- PCC foundation blocks with angle iron frame work edging for all power control centers and motor control centers.
- Substation fencing works.

3. DRAWINGS

The Electrical Drawings listed under Annexure-I, which shall be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. The architectural/interiors drawings and details shall be examined for exact location of equipment, electrical points & fixtures.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work and shall check the drawings of other trades to verify spaces in which his work will be installed. The contractor shall examine all architectural, structural, plumbing, and other services drawings and check the as-built works before starting the work and report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner.

4. SPECIFICATIONS

Technical Specifications to completely specify all aspects of design/construction features of equipments and all details of work to be carried out. Nevertheless the intent of the Technical Specification is to ensure that the equipments and the work shall fully comply with and conform to the relevant Bureau of Indian Standard Specifications, Codes of Practice, Indian Electricity Act, Indian Electricity Rules and other Statutory Regulations as may be applicable and to the best available standards of engineering, design and workmanship. The equipment and work shall perform in manner acceptable to Engineer-in-Charge who shall interpret meaning of the applicable Specifications/Codes and shall have the right to reject any equipment or work, which, in their assessment, is not complete to meet the Standard/Code.

5. TECHNICAL DATA FOR VARIOUS EQUIPMENTS / MATERIAL

Each tenderer shall submit along with his tender, the technical data for all items listed in **Annexure-III** in the indicated format. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

6. SHOP DRAWINGS

- All the shop drawings shall be prepared on computer through AutoCAD System based on Architectural Drawings/Interior Designer's plan. Within three weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for all conduit layouts, distribution panels, switch boards, cabinets, special pull boxes, cable trays and any other requirement to be fabricated or purchased by the contractor.
- These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance

characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/ works and progressive cumulative total from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Incase the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check print, for approval. The contractor shall submit further required sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

- Shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.
- Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
- Samples of all materials like conduits, accessories, switches, wires, control cables etc shall be submitted to the Owner's site representative prior to procurement. These shall be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project.
- Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.
- Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect//Consultant/ Owner's site representative.
- The contractor shall extend full co-operation to plumbing contractor in preparation of his coordinated services drawings. He shall issue soft copy and hard prints of his shop drawings to plumbing contractor well in advance to complete the co-ordinated services drawings in accordance with schedule prepared by the Owner site representatives. Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor

shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

- Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

7. PARTIAL ORDERING

Owner reserves the right to order equipment and material from any and all alternates, and /or to order high side and /or low side equipment and materials or parts thereof from one or more tenderers.

8. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be in conformity with list of approved manufacturers as per Annexure-V.

9. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project with minimum 8-10 years experience in this type of installation. The Contractor shall appoint Project Manager holding senior position in the organization with erection engineers & senior supervisors, posted at site on full time.

The Contractor's office at site shall be fully equipped with internet facility, computers, plotter and photocopier. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer who would be responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the air conditioning installation.

10. PERFORMANCE GUARANTEE

The contractor shall carry out the installation work strictly in accordance with the approved shop drawings, technical specifications, schedule of quantities and other documents forming part of the contract.

The contractor shall be fully responsible for the performance of the selected equipment at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the ELECTRICAL system as installed shall perform to complete satisfaction of the owner.

The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption

shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

11. LOCAL BYE-LAWS AND REGULATIONS

The work shall be carried out to the satisfaction of the Owner's site representative and in accordance with the Specifications, Regulations of the Electric Supply Authority, Indian Electricity Rules and Regulations, latest Indian Standards and as per the requirements of the any other local authority.

In case these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. In case if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

12. FEES AND PERMITS

The Contractor shall pay all relevant fees for obtaining permits required for the installation of this work. On completion of the installation, the contractor shall obtain certificate of final inspection and approval by the local electricity authority and any other authority approval and deliver to the Owner,

13. ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in wall cavities and suspended ceilings for proper installation of his conduits cables, cable trays, panels etc.. His failure to communicate insufficiency of any of the above shall constitute his acceptance of sufficiency of the same. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. The exact location and size of all access panels, required for conduits, cabling, cable trays or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense.

14. MANUFACTURERS INSTRUCTIONS

Incase manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

15. COMPLETION CERTIFICATE

On completion of the electrical 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, state/central govt./ municipal / fire authorities concerned.

16. INSPECTION AND TESTING

The Owner may carry out inspection and testing at manufacturer's works for this contract. No equipment shall be delivered without prior written confirmation from the Owner's site Engineer. In case factory inspection is carried out then all travelling and lodging expenses for two persons one from owner and one from consultants shall be borne by the Contractor, also all expenses related to testing shall be to Contractor account. Tests on site of completed works shall demonstrate the following:

That the equipment installed complies with specification in all respect and is of the correct rating for the duty and site conditions. That all circuits are fully protected and that protective devices are properly coordinated.

That all non-current carrying metal parts are properly and safely grounded in accordance with the specification and appropriate 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 Owner and shall provide test certificate signed by a authorized person. Such test shall be conducted on all materials and equipment and tests on completed work as called for by the Owner at contractor's expenses unless otherwise called for.

If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification of the same. Owner Site Engineer's decision as to what constitutes a satisfactory installation shall be final.

17. COMPLETION DRAWINGS

On completion of the work and before issuance of certificate of virtual completion the contractor shall submit to the Owner's site representative four sets of layout drawings in progressive manner for individual systems drawn at approved scale indicating the complete wiring system as installed. Drawings shall be prepared on AUTO-CAD (latest version) . along with the hard copies, the contractor shall submit copies of all drawings on CD and one set of all drawings on RTF shall also be submitted. These drawings must provide:

- a. Substation equipment layout & all power distribution panel layout.
- b. Single line power distribution diagram including control wiring.
- c. Cable trench with number and size of cables installed.
- d. Location and details of distribution boards/panels/feeder pillar, mains, switches along with phase balancing details.
- e. A complete wiring diagram as installed and single line diagrams showing all connections in the complete electrical system.
- f. Location of all earthing stations, route and size of all earthing conductors manhole.
- g. Layout and particulars of all HT & LT cables.
- h. Instruction, maintenance and operation manuals including maintenance schedule for all equipment. Testing & commissioning reports of all electrical equipment.
- i. Location of Telephone cabling alongwith cable/conduit routing of each. A single line diagram/schematic showing all connections for each of the LV services as stated above.

18. OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of Electrical system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit required sets of complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel.

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen working days of ten hours each, to enable the Owner's staff to get aquatinted with the

operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

19. MAINTENANCE DURING 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 require repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

20. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

21. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the Electrical installation for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of ONE years beyond the defects liability period.

I) Operation contract (Electrical System)

- 10 hours a day, year round during working office hours for full load
- 14 hours a day, year round during non-work hours for part load.
- All stand-by equipment to be operated as per mutually agreed programme.
- Proper entry and upkeep of relevant log books.
- Maintain complaints register. Submit weekly report.
- Proper housekeeping of all areas under the contract.
- Prepare daily consumption report and summary of operation.

II) All Inclusive Maintenance Contract

a. Scope.

The AMC shall cover all the items installed by the contractor including replacement of all switches, fittings etc. consumable like bulbs, tubes, oil etc. shall be excluded.

b. Routine Preventive Maintenance Schedule to be submitted

- Schedule to cover manufacturer's recommendation and/or common engineering practice (for all plant and machinery under contract).
- Plant and machinery history card giving full details of equipment and frequency of checks and overhaul.
- Monthly status report.

- Entire Electrical installation to be repainted in fourth year (from commissioning) before the expiry of operation and maintenance contract.
- c Manpower
 - Adequate number of persons to the satisfaction of the Owner's site representative shall be provided including relievers.
 - Statutory requirements of EPF, ESIC and other applicable labour legislations to be complied with; and monthly certification to that effect to be submitted.
 - Duty allocation and Roaster control shall be contractor's responsibility.
 - No overtime shall be payable by Owner for any reason whatsoever.
- d Shut Downs
 - Routine shut downs shall be permitted only as allowed by the Chief Engineer.
 - Contractor shall be at liberty to carry out routine maintenance as and when required but with prior permission of the Owner.
- e Payment Terms
 - Quarterly payment at the beginning of each quarter on pro-rata basis.

22. METHOD OF MEASUREMENT

The works shall be measured in accordance with relevant IS codes. Not with standing any general or local custom, except where otherwise specifically described or prescribed in the contract.

23. DEMONSTRATION TO OWNER

At completion, devices subject to manual operation shall be operated at least three times in presence of Owner's site representative to demonstrate satisfactory operation.

24. TOOLS AND TACKLES

The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, all transport for labour and materials and plant necessary for the proper execution and completion of the work to the satisfaction of the Owner's site representative.

SECTION – I : 12KV SF6 METAL ENCLOSED, INDOOR COMPACT SWITCHGEAR

1. SCOPE OF SUPPLY

This specification covers design, manufacture, shop testing, inspection, packing, delivery to site, erection, testing and commissioning of 12KV Metal Enclosed, panel type, extensible Indoor SF6 COMPACT SWITCHGEAR (CSG) fully type tested according to IEC 62271-200 standards.

The CSG should be complete with all components necessary for its effective and trouble free operation along with associated equipment etc. such components should be deemed to be within the scope of supplier's supply.

The design of the switchgear should be exclusive and specific responsibility of supplier and should be comply with current good engineering practice, the relevant codes and recommendation, the project specific requirements.

The manufacturer should have supplied & commissioned more than 500 SF6 insulated switchgears in the past 5 years to various utilities. Performance certificates for the same shall be furnished by the tenderer.

The CSG should be fixed type SF-6 insulated, with fixed type vacuum circuit breakers with O/C & E/F relay for the protection of the transformer inside single tank. It should be maintenance free equipment, having stainless steel robotically welded enclosure.

2. STANDARDS AND REFERENCE DOCUMENTS

2.1 Codes and Standards

The COMPACT SWITCHGEAR (CSG) should be designed, manufactured and tested according to the latest version of:

IEC 60694 Common specifications for high-voltage switchgear and control gear standards.

IEC 62271-200 : A.C metal-enclosed switchgear and control gear for rated voltages above 1KV and up to and including 72KV and the IEC Codes herein referred.

IEC 62271-102: Alternating current disconnectors (isolators) and earthing switches

IEC 60529 : Classification of degrees of protection provided by enclosures

IEC 60265 High-voltage switches-Part 1: Switches for rated voltages above 1kV and less than 52 kV

IEC 60056 : Circuit breakers

IEC 62271-105 High-voltage alternating current switch-fuse combinations

IEC 60185 Current transformers

IEC 60255 Electrical relays

Any other codes recognized in the country of origin of equipment might be considered provided that they fully comply with IEC standards.

The design of the switchgear should be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchangeability of equipment and ready addition of future loads.

3. 12KV SF6 Insulated Compact Switchgear (CSG)

Offered 12KV SF6 insulated Outdoor, Non extensible, Compact Switchgear (CSG), should comprise of 630 A Vacuum Circuit Breaker with (3 O/C & 1E/F) Relays. Minimum four functional units (cable switch/ VCB) can be accommodated in one single tank so as to make it more compact and reliable.

Vacuum Circuit Breaker (630A)

Circuit Breaker should have the following:

- Manual operated fixed type 630 A Vacuum circuit breaker with stored spring energy and Earthing Switch with making capacity
- Off load isolator with earth switch in series with VCB
- 3O/C + 1E/F self powered relay with Low and High set for Over current and Earth Fault. Relay should have LCD (16 x 2). Relay should have facility to trip the breaker from remote commands without shunt trip coil. Last 5 Fault Record with Time stamp, battery pack replaceable from front.
- GREEN(Close) / RED (Open) push buttons for VCB operation
- Low voltage compartment
- Ring core protection CT on cable 3001 A, 2.5 VA, 10P10
- Auxiliary contacts 1NO and 1NC
- Anti-reflex operating handle
- "Live Cable" LED Indicators thru Capacitor Voltage Dividers mounted on the bushings.
- Mechanical ON/OFF/EARTH Indication
- Cable boxes suitable for 1 X 3C x 240 sq mm XLPE Cable with right angle Cable Termination protectors & arc proof cable doors

4. GENERAL TECHNICAL REQUIREMENTS

4.1 Service Conditions

- The Compact Switchgear shall be suitable for operations at a height of 1000 meters above sea level, IEC 60120.
- The CSG shall be capable of operating normally within the following temperature ranges:
 - Maximum air temperature: +40 deg C
 - Maximum value for 24 Hr mean: +35 deg C
 - Minimum air temperature: - 20 deg C
- The Compact switchgear shall be capable of being exposed to high relative humidity (max 95%) and ambient air pollution.
- The Compact switchgear shall be capable of being operated in electrically exposed locations.

4.2 Design Parameters

4.2.1 Compact Switchgear, Electrical data

Sr. No	Rated voltage	KV	12 KV
1	Power frequency withstand voltage	KV	28
2	Impulse withstand voltage	KV	75
3	Rated frequency	Hz	50
4	Rated current busbars	A	630
5	Rated current (cable switch)	A	630
6	Rated current (T-off)	A	630

Breaking capacities:

7	active load	A	630	
8	closed loop (cable switch)	A	630	
9	off load cable charging (cable Switch)		A	135
10	earth fault (cable switch)	A	200	
11	earth fault cable charging (cable switch)		A	115
12	short circuit breaking current (T-off VCB)	kA	20	
13	Rated making capacity		kA	50
14	Rated short time current 3 sec.		kA	20

4.2.2 General data, enclosure and dimensions

1	Standard to which Switchgear complies	IEC
2	Type of Compact Switchgear	Outdoor, Metal Enclosed, bolted type.
3	Number of phases	3
4	Whether CSG is type tested	Yes
5	Whether facility is provided with pressure relief	Yes
6	Insulating gas	SF6
7	Nominal operating gas pressure	1.4 bar abs. 20° C
8	Gas leakage rate / annum %	0.1 % per annum
9	Expected operating lifetime	30 years
10	Whether facilities for gas monitoring	Yes, temperature compensated manometer can be delivered
11	Material used in tank construction	Stainless steel sheet, 2.5/3
	mm	

4.2.3 No. of Operations, degree of protection and colours

1	Means of switch operation	separate handle
2	Means circuit breaker operation	separate handle and push buttons
3	Rated operating sequence of Circuit Breaker	O –3min-CO-3min-CO
4	Total opening time of Circuit Breaker	approx. 60 ms
5	Closing time of Circuit Breaker	approx. 70 ms
6	Mechanical operations of switch	CO 1000
7	Mechanical operations of earthing switch	CO 1000
8	Mechanical operations of circuit breaker	CO 2000
9	Principle switch / earth switch	3position combined
	switch	

4.2.4 Degree of protection:

10	High Voltage live parts,	SF6 tank IP 67
11	Front cover mechanism	IP 2X
12	Cable covers	IP 3X
13	Enclosure	IP 55

4.2.5 Colours:

14	Front cover	7035
15	Cable cover	7035
16	Enclosure	Dark Admiral Grey

4.3 General Structural and Mechanical Construction

The offered CSG should be of the fully arc proof metal enclosed, free standing, floor mounting, flush fronted type, consisting of modules assembled into one or more units. Each unit is made of a robotically welded sealed-for life stainless steel tank of thickness not less than 2.5 mm filled with SF6, containing all high voltage components sealed off from the environment with Ingress protection IP67. The enclosure should meet the 'sealed pressure system' criterion in accordance with IEC 62271-200 standard (i.e a system for which no handling of gas is required throughout the 30 years of service life), so that no refilling of gas is required. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. The overall design of the switchgear should be such that front access only is required. It should be possible to erect the switchboard against a substation wall, with HV and LV cables being terminated and accessible from the front.

The design of the units should be such that no permanent or harmful distortion occurs either when being lifted by eyebolts or when moved into position by rollers.

CSG must have a pressure relief device at the bottom of the stainless steel housing to ensure that in the rare case of an internal arc, the high pressure caused by the arc will be released and the hot gases are allowed to be exhausted out at the bottom of the cubicle towards back side to ensure complete safety to the operator. A controlled direction of flow of the hot gas should be achieved.

4.4 DIELECTRIC MEDIUM

SF6 gas shall be used for the dielectric medium for 12KV CSGs in accordance with IEC376. It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. The SF6 insulating medium shall be constantly monitored via a temperature compensating gas pressure indicator offering a simple go, no-go indication. Maximum gas pressure shall be 1.4 bar absolute.

4.5 Circuit Breakers

The 630Amp circuit breaker module should consist of an SF6 cubicle housing a fixed type vacuum circuit breaker & earthing switch. An integrated relay and related CTs is used for tripping of the circuit breaker. The VCB should be equipped with a series disconnecter. Bus bars and all electrical connections should be located inside the tank. Bus bars inside the SF6 tank should not be sleeved. The operating shafts for the switches should be have rotary seals where they enter the SF6 cubicle. The operating mechanisms are located outside on the front of the SF6 tank. Bolted type cable bushings should be located on the front of the SF6 cubicle in a separate cable compartment. Front covers containing the mimic diagram having a degree of protection IP2X seal off the fronts.

Vacuum bottles should be use as interrupters of the currents. The make of vacuum bottles should be same as that of CSG. The circuit breaker main circuit should be connected in series with a three-position disconnecter –ear thing switch. The operation between circuit breaker and disconnecter earthing must be interlocked. VCB shall use a self powered relay with low burden trip coil. Relay shall draw the required energy from ring core CTs mounted on cables in the cable compartment.

4.6 Earthing of the Main Circuit

Each VCB shall be provided with an integral earth switch. Earthing switches should be

rated equal to the switchgear rating. Earthing switches should be quick make type capable of making Rated Fault Current. Earthing switch should be operated from the front of the cubicle by means of a removable handle. The earthing switch can be operated only when the isolator/circuit breaker are open.

Mechanical interlocking systems shall prevent all operator errors such as closing the earth switch when switch is closed.

The HT cables are terminated in the dedicated cable. At the bottom of the cable compartment, an earthing bar system made of copper with a minimum cross section of 120 sqmm should be fitted. The earthing system is connected to the tank by a copper bar, which rises up to the connecting point of the tank behind the rear partition wall on the middle of the switchgear.

4.7 Operating Mechanisms

All mechanisms should be situated in the mechanism compartment behind the front covers outside the SF6-tank.

The mechanism for the VCB series switch and earthing switch is operating both switches via one common shaft. The mechanisms has stored spring energy and provide independent manual operation for closing and opening of the switch. The mechanism for the vacuum circuit breaker (VCB) and disconnector- earthing switch is operating the VCB and the disconnector earthing switch via to separate shafts. The mechanism for the VCB has stored spring energy and provides independent manual operation for closing and opening of the VCB. The mechanism has a relay with related CT's and/or remote tripping device. In rare case of mechanism failure, it shall be possible to replace the same at site without requiring SF6 gas refilling.

4.8 Interlocking

The mechanism for the VCB should provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position. The mechanism for the VCB and the disconnector-earthing switch should be has a built in interlocking system to prevent operation of the disconnector-earthing switch when the VCB is in the closed position.

Further is should not be possible to Open the Cable doors unless the Earthing Switch is Turned ON. In case the Cable door is accidentally left open a positive interlock shall prevent operation of Load Break Switch and Isolators / Breaker from any operation.

4.9 Busbars

Comprising the 3 single phases copper bus bars and the connections to the switch or circuit breaker. The bus bar should be integrated in the cubicle Bus bars should be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.

4.10 Front Covers

The front cover contains the mimic diagram of the main circuit with the position indicators for the switching devices. The voltage indicators are situated on the front panels. Access to the cable bushings is in the lower part of each module.

4.11 Position Indicators

The position indicators shall be visible through the front cover and must be directly linked to the operating shaft of the switching devices. The operator shall be able to

confirm the closing of earth switch. Same can be accomplished either by providing a viewing window for earth switch or by means of true position indication duly type tested as per IEC 62271-102 sub clause A.6.105 to verify proper functioning of position indicating device.

4.12 Voltage Indicators

The voltage indicators are situated on the front cover, one for each module, and indicate the voltage condition of each incoming cable. Identification of the phases is achieved with labels L1, L2 and L3 on the front of the voltage indicators. The voltage indicator satisfies the requirements of IEC61243.

4.13 Cable Compartment

It should be possible to terminate up to a 1x 3c x400 sq.mm core HV cables in each cable compartment. The cable compartments should be in front only and cable entry shall be from bottom. The access to the compartment will be possible by removing the cable cover, hinged to the main frame only when earth switch is ON. Removable type cable covers are not acceptable. Cable Compartments should be Arc Proof and interlocked with respective Earth Switches. Each module has a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall should be fitted to divide the cable compartment from the rear side of the switchgear. In case of an arc inside the tank, followed by the opening of the pressure relief, the partition wall prevents the hot gases flowing out from the pressure relief to enter the cable compartments. The ground continuity is achieved when the covers are in place by means of hinged connections.

Suitable base frame shall be provided for ease of termination of three core cable. The trifurcation of the cable shall be inside the base frame & the crotch should not hang outside the base frame.

It should be possible to perform cable testing inside the cable boxes without disconnecting the cables.

4.14 Extensibility

The CSG shall be extensible on single/both sides or Non Extensible as per BoQ. The bushings for coupling of two units shall be bolted type and at the top of unit for ease of access and commissioning. Side extensibility is not acceptable as it increase the space requirement. Plug-in type coupling is not acceptable as precise leveling is required for the same.

4.15 Padlocking Facilities

The circuit breakers, isolators and the earthing switches can be locked in open or closed position by padlocks 6 to 8 mm in diameter.

4.16 Current Transformer

All current transformers should be complying with IEC 60185.

Current transformers should be of dry type, with ratings and ratios as required.

Cable current transformers used in circuit breaker modules should be maximum 115mm wide.

Current transformer shall be placed in the cable covers so that it can be easily replaced at site without removing the bushings. CT's on bushings are not acceptable.

5. Manufacturing Facility

The manufacturer shall ensure workmanship of high quality. There shall be adequate machinery tools and tackles such that the product shall meet the internationally

accepted standards. Facility should be certified for ISO 9001, 14001 and OHSAS 18001. The manufacturing facility shall be equipped with the following:

- Robotic welding station for stainless steel main tank, ensuring a leak rate of less than 0.1% per year.
- Work benches with pneumatic adjustable work benches and torques wrenches, giving flexibility to workmen for proper tightness of internal components of sealed tank.
- State of the art fully automatic gas filling and leakage testing machine for ensuring the quality of sealing and have precision to measure leak rate less than 0.1% per year.
- High voltage testing station to have high voltage power frequency test and partial discharge measurement.
- Computerized system to measure time travel characteristic of breaker before sealing the tank.

6. TESTING AND CERTIFICATION.

6.1 Type Tests.

Units should be type tested in accordance with IEC standards 60056, 62271-102, 60265, 62271-200, 62271-105, 60529 and 60694. The following type tests have been performed and available if required

- Short time and peak withstand current test
- Temperature rise tests
- Dielectric tests
- Test of apparatus i.e. circuit breaker and earthing switch
- Arc fault test
- Measurement of resistance of main circuit.
- Mechanical endurance test.
- Duty cycle test.
- Internal arc test.
- Degree of protection for ingress.
- Tests to verify true position indication devices as per IEC 62271-102.

Type test reports for above type shall be submitted with the offer.

6.2 Routine tests

Routine tests should be carried out in accordance with IEC 62271-200 standards. These tests should ensure the reliability of the unit.

Below listed test should be performed as routine tests before the delivery of units:

- Withstand voltage at power frequency
- Measurement of the resistance of the main circuit
- Withstand voltage on the auxiliary circuits
- Operation of functional locks, interlocks, signaling devices and auxiliary devices
- Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- Verification of wiring
- Visual inspection
- Time travel characteristics measurement facility for Breaker should be available with the manufacturer to assess the quality of CSG.

7. TRAINING

Installation of the switchgear should be required no special tools. Optional product training should be available at the manufacturer's facility.

SECTION II- COMPACT TYPE 11 KV RING MAIN UNIT

1. GENERAL

This specification covers design, engineering, manufacture, shop testing, inspection, Painting, packing, supply, forwarding, delivery to site, erection, testing and commissioning of 11kV Ring Main Units complete with all accessories. The above scope of work also includes statutory clearances from the relevant authorities.

It is not the intent to specify completely herein all details of the equipment; nevertheless, the equipment shall be complete and operative in all respects and shall conform to the highest standard of engineering, design and workmanship.

Should the bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation by listing the deviations in the deviation schedule without which his offer will be considered in conformity with the specification in all respects.

The design of the switchgear shall be based on safety to personnel and equipment during operation and maintenance, reliability of service, ease of maintenance, mechanical protection of equipment, interchange ability of equipment and ready addition of future loads.

2. CODES AND STANDARDS

In order to be accepted, the switchgear shall comply with the requirements stated in the latest editions of the following recommendations, standard and specifications:

- IEC standards
- IEC 60298 MV metal-enclosed switchgear,
- IEC 60265 MV switches,
- IEC 60129 AC disconnectors and earthing switches,
- IEC 60694 common clauses for MV switchgear standards,
- IEC 60056 MV AC circuit breakers,
- IEC 60801 monitoring and control
- IEC 60529 degrees of protection procured by enclosures (IPcode).

3. SCOPE OF WORK

Supply, Installation, commissioning and testing of 11KV, 3 phase, 50 Hz ,3 wire , 630 amps Copper Bus Bar indoor/outdoor type floor mounted ,non extensible ,having hinged arc proof cable doors ,Cable termination from the front, breaking capacity 21kA/3 Sec. SF6 Ring Main Unit enclosed in robotically laser welded stainless steel tank having IP67 degree of protection, Leak rate of SF6 gas should be less than 0.1% and tested as per IEC 60056/60694/60298. This stainless steel tank should accommodate at least five modules in one tank to avoid multiple extension.

4. SPECIAL MAINTENANCE TOOLS & TACKLES

The contractor shall provide a list of recommended spare parts with their individual prices for equipment to be supplied against this specification. This list shall identify all essential spares items for any recommended maintenance for a period of five years after commissioning. The Owner's site representative may order all or any of the spare parts listed at the time of contract award and the spare parts so ordered shall be

supplied as part of the definite works. The Owner's site representative may order additional spares at any time during the contract period.

The contractor shall give an assurance that spare parts and consumable items will continue to be available through the life of the equipment, which shall be 25 years minimum. However, the Contractor shall give a minimum of 12 months notice in the event that the Contractor or any sub-contractors plan to discontinue manufacture of any component used in this equipment.

Any spare apparatus, parts or tools shall be subject to the same specification, tests and conditions as similar material supplied under the Contract. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the plant and must be suitably marked and numbered for identification.

Spare parts shall be delivered suitably packed and treated for long periods in storage. Each pack shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts list in the operation and maintenance instructions,

5. GENERAL TECHNICAL REQUIREMENTS:

Service conditions:

The RMU shall be capable of operating normally within the following temperature range:

- Maximum air temperature: + 45° C
- Minimum air temperature: - 0° C
- Manufacturer shall declare whether the RMU is able to operate in air temperature higher than + 45°C over the ambient of 35 deg centigrade and if current de-rating is necessary.
- The RMU shall be capable of being operated in electrically exposed locations.
- The RMU shall be capable of being exposed to high relative humidity and ambient air pollution.
- The RMU shall be capable of being operated in Indoor switch room.

System Parameters:

General Technical Requirements	
Network	Three phases - Three wires
Rated Voltage	12kV
Service Voltage	11kV
System Frequency - Hz	50 Hz
Bus bar Rating- A	630
Min Gas pressure - BarG	0.05
Filling pressure- BarG	0.3
Min operating temperature – Deg C	- 25
IP Rating	IP 3X / 67
Internal Arc test	IEC60298
Lightning Impulse withstand Voltage	95 kV Peak
Power Frequency withstand voltage	28 kV RMS - 1 min
Rated Normal Current	
Incomer Load Break Switch	630 A
Feeder Circuit-breaker	630A

Rated Short time current withstand (1 sec)	21 kA
Rated Short circuit making capacity of line switches and earthing switches	52.5 kA peak at Rated Voltage
Rated load interrupting current Incomer Load Break Switch	630 A rms
Rated cable charging interrupting current Incomer Load Break Switch	30 A
Rated magnetizing interrupting current Incomer Load Break Switch	16 A

General data, enclosure and dimensions – RMU	
Standard to which Switchgear complies	IEC
Type of Ring Main Unit	Metal Enclosed
Number of phases	3
Whether RMU is type tested	Yes
Whether facility is provided with pressure relief	Yes
Insulating gas	SF6
Nominal operating gas pressure	1.4 bar abs. 20° C
Gas leakage rate / annum	% 0.1
Expected operating lifetime	30 years
Material used in tank construction	Stainless steel sheet, 3 mm

General data, enclosure and dimensions – Circuit Breaker	
Means of switch operation	separate handle
Means circuit breaker operation	separate handle and push buttons
Rated operating sequence of Circuit Breaker	O –3min-CO-3min-CO
Total opening time of Circuit Breaker	approx. 45ms
Closing time of Circuit Breaker	approx. 40ms
Principle switch / earth switch	3position combined switch / earth switch
Degree of protection:	
High Voltage live parts, SF6 tank	IP 67
Front cover mechanism	IP 55
Cable covers	IP 55
Colours:	
Front cover	RAL 7012
Side and cable cover	RAL 7035

6. General Stipulations regarding the Design and Development of Switchgear

Introduction

The RMU shall meet the criteria for compact, metal-enclosed Indoor switchgear in accordance with IEC 60298.

Switchboards

The RMU shall be of the fully arc proof metal enclosed, free standing, floor mounting, flush fronted type. Each unit is made of a cubicle sealed-for life with SF6 and contains all high voltage components sealed off from the environment.

The switchgear and busbar shall all be contained in a stainless steel enclosure filled with SF6 gas. The enclosure should meet the "sealed pressure system" criterion in accordance with the IEC 60298 standard (i.e. a system for which no handling of gas is required throughout the 30 years of service life), so that refilling is not required. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0,1 % / year. It should Provide full insulation, making the switchgear insensitive to the environment (temporary flooding, high humidity...), IPX7 degrees of protection in accordance with recommendation IEC 60529. The active parts of the switchgear shall be maintenance-free and the switchboard shall be low-maintenance.

The overall design of the switchgear shall be such that front access only is required. It shall be possible to erect the switchboard against a substation wall, with HV and LV cables being terminated and accessible from the front.

The cubicle shall have a pressure relief device. In the rare case of an internal arc, the high pressure caused by the arc will release it, and the hot gases is allowed to be exhausted out at the bottom of the cubicle. A controlled direction of flow of the hot gas should be achieved.

The tank shall be made of at least 2 mm AISI 304 unpainted stainless steel. The switchboards shall be suitable for mounting on a trench, utilities space or base.

Each switchboard shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics.

The switchgear and switchboards shall be designed so that the position of the different devices is visible to the operator on the front of the switchboard and operations are visible as well.

In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

Dielectric medium

SF6 gas is the preferred dielectric medium for MV RMUs. SF6 gas used for the filling of the RMU shall be in accordance with IEC 60376.

It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption.

Earthing of metallic parts

There shall be continuity between the metallic parts of the switchboard and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people.

The substation frames shall be connected to the main earth busbar without dismantling any busbars.

Earthing of the main circuit

The cables & feeders shall be earthed by an earthing switch with short-circuit making capacity, in compliance with IEC 60129 standard. The earthing switch can only be operated when the main Load break switch / Circuit Breaker is open.

The earthing switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action.

Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earthing switch when the switch is closed.

Incomer Load Break Switches

It shall consist of an SF6 cubicle housing a switch disconnecter and an earthing switch. They shall be maintenance-free, with breaking in low pressure SF6 gas. Busbars and all electrical connections are located inside the tank. The operating shafts for the switches shall have rotary seals where they enter the SF6 cubicle. The operating mechanisms shall be located outside on the front of the SF6 tank.

The position of the power contacts and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 60265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 60129 .

The switches shall be of the "increased operating frequency" in accordance with IEC 60265-1. They shall have at least 2 positions, open-disconnected & closed and will be constructed in such a way that natural interlocking prevents unauthorized operations. Earthing of the cable shall be either through a three position switch of a separate snap action type Earth Switch having fault making capacity. The Mechanism shall be constructed in such a way that natural interlocking prevents unauthorized operations.

The switches shall be fully mounted and inspected in the factory.

Manual opening and closing will be driven by a fast-acting mechanism, independent of operator action.

Each switch can be fitted with an electrical operating mechanism in a specially reserved location, without any modification of the operating mechanism and without de-energizing the switchboard.

"Feeder and Local Transformer Control circuit-breaker" feeders.

Each T-off circuit breaker module shall consist of an SF6 cubicle housing a vacuum circuit breaker unit and a disconnecter-earthing switch. The operation between circuit breaker and disconnecter-earthing is interlocked .An integrated relay and related CT's is used for tripping of the circuit breaker. Bus bars and all electrical connections are located inside the tank. The operating shafts for the switches shall have rotary seals

where they enter the SF6 cubicle. The operating mechanisms are located outside on the front of the SF6 tank.

The circuit breakers shall be of the maintenance-free, Vacuum type. The position indicator shall provide positive contact indication in accordance with IEC 60265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 60129.

The circuit breakers shall have 2 positions: open-disconnected & closed and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. The earthing of the feeder shall be by a Fault Making Earth Switch. The earth switch shall be mechanically interlocked with the isolators / breaker to prevent any unauthorized operation.

They shall be fully mounted and inspected in the factory.

An operating mechanism can be used to manually close the circuit breaker and charge the mechanism in a single movement.

It shall be fitted with a local system for manual tripping by an integrated push button. There will be no automatic re-closing.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include:

- Three current transformers
- An electronic relay,
- A low energy release,
- A "fast-on" test receptacle for protection testing (with or without CB tripping)

The protection system will ensure circuit breaker tripping as of a minimum operating current (Is) which is the rated current of the underground network to be protected and may be set to following ratings from 12 to 600 A. Following settings shall be available :

Range 1 - 16 to 56 A :

Range 2 - 32 to 112 A :

Range 3 - 64 to 224 A

Range 4 – 128 to 448 A

The phase protection shall have two separately adjustable settings:

- The low setting may be chosen with definite time or IDMT. The IDMT curves shall be in compliance with the IEC 255-3 standard. They are of the standard inverse, very inverse and extremely inverse types.
- The low setting may also be used with the RI curve.
- The high setting shall be of the definite time type earth protection
- The earth fault protection shall operate by residual current measurement: it uses the sum of the sensor secondary currents.
- Like phase protection, earth protection shall be fitted with two separately adjustable settings.
- There should be provision of flag Relay on each outgoing vacuum breaker module for indication of Trip on Fault.

- Provision for testing of cable by suitable arrangements with following to be confirmed and provided:

Doors can be opened only with the Earth Switch in Closed position. A cable test rod has to be provided which can be fixed on the terminations to facilitate testing. Termination boots should have a proper opening to facilitate the same. The opening should be covered by means of removable protection cap. MECP / Raychem or boots used in terminations must have this facility. In case of front door opened, it should not be possible to operate the load break switches / isolators or breaker.

- The cable cover door should be pad lockable and should be Tamper and Arc proof as per IEC 60298.
- Cable charge indication should be provided for Each RMU.
- One No Phase Comparator must be provided with each RMU (4 function or 3 function RMU)
- Provision for cable door interlocks such that the doors cannot be opened unless the Earth switch is closed
- There should be provision of hinged doors in the RMU.

7. RMU bushings and Cable terminations

➤ Bushing

The bushing should be conveniently located for working with cables specified and allow for the termination of these cables in accordance with the instructions supplied. The profiles of the cable connection bushings shall be in compliance with EN-50181 standard.

➤ Cable clamps

A non ferro-magnetic cable clamp arrangement must be provided for all network cables terminated on the RMU

➤ Padlocking facilities

The circuit breakers and earthing switches can be locked in the open or closed position by 1 to 3 padlocks 6 to 8mm in diameter.

➤ Voltage indicator lamps and phase comparators

Each function shall be equipped with a voltage indicator box on the front of the device to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps.

Three inlets can be used to check the synchronization of phases.

This device shall be in compliance with IEC 61958 standard.

➤ Safety of people

Any accidental overpressure inside the sealed chamber will be limited by the opening of a pressure limiting device in the rear part of the enclosure. Gas will be released to the rear of the switchboard away from the operator. Manufacturer shall provide type

test report to prove compliance with IEC 60298 appendix AA 'Internal fault'.

➤ **Operating lever**

An anti-reflex mechanism on the operating lever shall prevent any attempts to reopen immediately after closing of the switch or earthing switch. All manual operations will be carried out on the front of the switchboard. The effort exerted on the lever by the operator should not be more than 250 N for the switch and 250 N for the circuit breaker.

➤ **Front plate**

The front plate shall have an IP2XC degree of protection. The front shall include a clear mimic diagram which indicates the different functions.

The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator.

The lever operating direction shall be clearly indicated in the mimic diagram.

The manufacturer's plate shall include the switchboard's main electrical characteristics.

➤ **Fault Passage Indicators**

Fault Passage Indicators shall be installed on the Ring Main Unit. The Bidder shall supply One FAULT INDICATOR per Load Break Disconnecter Switch. These devices shall be electronic devices with their own energy source and shall be provided with bright LEDs / flag Indicators, which shall be clearly visible in the daytime. They shall have the following resetting facilities:

Manual reset and, Resetting after a set time duration and Resetting on restoring of LV

The unit shall have Short Circuit adjustable to different settings and Earth fault setting with separate Current transformer. It should be possible to Test these indicators at site thru "Test" push button. The Fault Passage Indicators should also be provided with a SCADA output contact. They should confirm to the following standards:

IEC 60068-2-6, IEC 60068-2-9 & IEC 60529	: Mechanical Test
IEC 60950	: Electrical Security
IEC 1000-4 and IEC 1000-6	: EMI / RFI
IEC 1000-4-2	: Air Discharges

They should have CE marking.

➤ **Busbars**

Comprising the 3 single phases copper busbars and the connections to the switch or circuit breaker. The busbar shall be integrated in the cubicle Busbars shall be rated to withstand all dynamic and thermal stresses for the full length of the switchgear.

➤ **The cable switch**

It shall be a switch-disconnector and earthing switch using SF6 gas as an arc-quenching medium. The switch positions are closed – open – earthed. In the open position the switch satisfies the disconnector requirements.

8 Earthing Switch

Earthing switches shall be rated equal to the switchgear rating. Earthing switches shall be quick make type capable of making Rated Fault Current. Earthing switch shall be operated from the front of the cubicle by means of a removable handle.

➤ **The mechanisms**

All mechanisms shall be situated in the mechanism compartment behind the front covers outside the SF6-tank.

The mechanism for the switch and the earthing switch is operating both switches via one common shaft. The mechanism provide independent manual operation for closing and opening of the switch, independent closing of the earthing switch and dependent opening of the earthing switch.

The mechanism for the T-off switch and earthing switch is operating both switches via one common shaft. The mechanism has stored spring energy and provide independent manual operation for closing and opening of the switch, independent closing of the earthing switch and dependent opening of the earthing switch. The mechanism has fuse tripping device.

The mechanism for the vacuum circuit breaker (VCB) and disconnector-earthing switch is operating the VCB and the disconnector-earthing switch via to separate shafts. The mechanism for the VCB has stored spring energy and provides independent manual operation for closing and opening of the VCB. The mechanism has a relay with related CT's and/or remote tripping device. The mechanism for the disconnector-earthing switch provide independent manual operation for closing and opening of the disconnector, independent closing of the earthing switch and dependent opening of the earthing switch.

9 Cable compartment

It shall be possible to terminate up to a maximum of two single core HV cables per phase. The access to the compartment will be possible by removing the cable cover, bolted to the main frame.

Removable steel covers close the cable compartments. Arc proof cable covers shall be available as option. Each module has a separate cable compartment that is segregated from each other by means of a partition wall. A partition wall shall be fitted to divide the cable compartment from the rear side of the switchgear. In case of an arc inside the tank, followed by the opening of the pressure relief, the partition wall prevents the hot gases flowing out from the pressure relief to enter the cable compartments. All covers are removable. The ground continuity is achieved when the covers are in place by means of bolted connections.

10 Power connection,

The cables are installed in the dedicated compartment below the mimic front cover. At the bottom of the cable compartment, an earthing bar system made of copper with a minimum cross section of 150 mm² shall be fitted. In each compartment the earthing bar shall be fitted with 4 screws M10. The earthing system is connected to the tank by a copper bar, which rises up to the connecting point of the tank behind the rear partition wall on the middle of the switchgear.

11 Inter Locking

The mechanism for the cable switch shall provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position.

The mechanism for the T-off switch shall provide a built in interlocking system to prevent operation of the switch when the earthing switch is closed, and to prevent operation of the earthing switch when the switch is in the closed position. In addition an interlocking device allows access to the fuses only when the earthing switch is in the earthed position and opening of the earthing switch is only possible when the fuse cover is closed and secured.

The mechanism for the VCB and the disconnecter-earthing switch shall have a built in interlocking system to prevent operation of the disconnecter-earthing switch when the VCB is in the closed position.

12 Current Transformers

All current transformers shall comply with IEC 60185.

Current transformers shall be of dry type, with ratings and ratios as required.

Cable current transformers used in circuit breaker modules shall be maximum 100mm wide.

Current transformers used in metering cubicles shall have dimensions according to DIN 42600, Narrow type.

13 TESTS

Routine Tests shall be conducted on the Ring Main Units in accordance with the latest versions of IEC. Type Test certificates for tests conducted earlier on similar equipment shall be furnished.

TYPE TESTS

Units shall be type tested in accordance with IEC standards 60056,60129,60265,60298,60420,60529 and 60694. The following type tests have been performed and available if required.

- Short time and peak withstand current test
- Temperature rise tests
- Dielectric tests
- Test of apparatus i.e. circuit breaker and earthing switch
- Arc fault test

ROUTINE TESTS

Routine tests shall be carried out in accordance with IEC 60298 standards. These tests shall ensure the reliability of the unit. Below listed test shall be performed as routine tests before the delivery of units;

- Withstand voltage at power frequency
- Measurement of the resistance of the main circuit
- Gas leakage test
- Withstand voltage on the auxiliary circuits
- Operation of functional locks, interlocks, signalling devices and auxiliary devices
- Suitability and correct operation of protections, control instruments and electrical connections of the circuit breaker operating mechanism
- Verification of wiring
- Visual inspection

Tests shall be performed in the presence of Purchaser's representatives. The Contractor shall give at least fifteen (15) days advance notice for witnessing the tests. Copies of certified reports of all tests carried out at works shall be furnished. The equipment shall be dispatched from works, only after receipt of Purchaser's written approval of the test reports.

Each completely wired Ring Main Unit shall be tested to ensure that all of its protective, control and interlock systems are satisfactorily functioning in the manner as required.

The Bidder shall indicate tests recommended to be carried out at site during installation and commissioning to ensure satisfactory performance of all the equipment supplied.

SECTION-III : HT CABLE

1. GENERAL

Cables shall be aluminium conductor, cross linked polyethylene construction and shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Standard Specifications and cable manufacturers instructions.

2. MATERIAL

- a. Conductor : The Conductor shall be made from electrical purity aluminum stranded wires compacted together.
- b. Insulation : High quality TROPOTHEN - X (XLPE) unfilled insulating compound of natural colour shall be used for insulation. Insulation shall be applied by extrusion process and shall be chemically cross linked in continuous vulcanization process.
- c. Shielding : Cables shall be provided with conductor shielding as well as insulation shielding and shall consist of extruded semi-conducting compound, additionally insulation shield shall be provided with semi-conducting and metallic tape shield over the extruded insulation shield. XLPE insulation and outer core shielding shall be extruded in one operation.
- d. Armouring : Armouring shall be applied over the inner sheath and shall comprise of flat steel wires (strips).
- e. Outer Sheath : Tough outer sheath of heat resisting PVC compound shall be extruded over the armouring in case of armoured cables or over extruded over the armouring in case of armoured cables or over inner sheath in the case of unarmoured cables.

3. TESTS

Cables shall be type tested and routine tested in accordance with IS:7098 (Part II).

- Conductor resistance test.
- Partial discharge test.
- High Voltage test.

The following tests shall be carried out at site for insulation between phases and between phase and earth before and after cable laying.

- Insulation Resistance Test.
- Continuity resistance test.
- Sheathing continuity test.
- Earth test.
- High Voltage test.

Cables shall be laid with a clearance of at least 75 mm between two cables.

4. END TERMINATION OF HT CABLE

Pre-moulded cable terminations for XLPE cable shall be used as per manufacturer's instructions. The steel cone of M-seal Push-On shall consist of highly track resistant insulating section vulcanized to a semi-conducting section. The pad material shall have cold-flow properties and shall be flame retardant. Each end terminal shall undergo Hi Pot Test.

5. LAYING OF HT CABLES

Direct In Ground

The work shall involve excavation of trench and laying of cable(s) as indicated in drawing and Schedule of Quantities.

The depth of the excavation shall not be less than 900 mm for 11 KV plus radius of cable, from the upper surface of ground. Where more than one multicore cable is laid in the same trench, a horizontal inter spacing of 250 mm shall be left in order to reduce mutual heating and also to ensure that fault occurring on one cable will not damage the adjacent cable.

Cable shall be laid in cement pipes encased in concrete or hume pipes at all road crossing. Cables shall be laid in trenches over rollers placed inside the trenches. After the cable has been properly laid and straightened, it shall be covered with 80 mm thick layer of sand. Cable shall then be lifted and placed over this sand cushion. Again, the cable shall be covered with a 80 mm layer of sand. Over the sand a layer of cable protection tiles shall be placed by overlapping 50 mm on either side. Trenches shall then be back-filled with earth and shall be consolidated. Suitable cable markers made of cast iron with aluminium paint indicating the voltage grade and direction of run of the cables shall be installed at regular intervals.

6. RCC/MASONRY TRENCH

For laying of HT cable in RCC/Masonry trench refer detail on sub-station layout drawing and IS-1255-1983.

SECTION IV : OIL TYPE DISTRIBUTION TRANSFORMER

1. GENERAL

Technical specifications in this section covers supplying, installation, testing and commissioning of step down 11000/433 volts, double wound core type, delta/star, naturally oil cooled transformers.

The equipment shall be of type tested design at CPRI /Independent test house for short circuit, temperature rise and dielectric tests of the ratings required as per Tender.

2. STANDARDS AND CODES

All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date and as below. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

Equipments certified by Bureau of Indian Standards shall be used in this contract in line with government regulations. Test certificates in support of this certification shall be submitted, as required.

It is to be noted that updated and current standards shall be applicable irrespective of dates mentioned along with ISS's in the tender documents.

Transformer	IS : 2026
Transformer Oil	IS : 335
Fittings and accessories for power transformers	IS : 3639
Loading of Oil immersed transformers	IS : 6600
Routine tests	IS : 2026
Buchholz relay	IS : 3637
Electrical Insulation classified by thermal stability	IS : 1271
Insulation and maintenance	

3. TRANSFORMER DETAILED SPECIFICATIONS

(i) TRANSFORMER OPERATION

The transformer shall be suitable for operation on 11 kV, 3 phase 50 cycle earthed system, connected Delta on H.V. side and star on the L.V. side with neutral brought out for independent earthing (Vector Group DYn II). The transformer shall be suitable for continuous operation at the rated capacity under Site conditions.

(ii) TRANSFORMER MATERIAL

The material used in the manufacture of the transformer shall be of the best quality of their respective kind available as per standard specifications.

(iii) CORE

The core shall be built up with high grade non-aging, low loss and high permeability CRGO lamination special silicon steel suitable for transformers. After being sheared, the lamination shall be treated to remove all burs and shall be reannealed to remove all residual stresses. Each lamination shall be coated with a durable, insulating coating. Core assembly shall be provided with lugs suitable for lifting the complete core and coil assembly of the transformers. Core and coil shall be so fixed that there is permanent displacement of windings on other parts when the transformer is moved or during short circuit. Core frame parts shall be galvanized.

(iv) WINDINGS

The HV and LV windings shall be of copper conductors using highly densified glass fiber reinforcement. Temperature rise of winding shall not 50 deg C by resistance on continuous full load above ambient of 50°C and temperature rise of oil shall not exceed 45 deg C above ambient of 50 deg C. Flux density at any point in winding and core shall not exceed 1.7 T on normal rated voltage and frequency.

(v) INSULATION CLASS

The insulation material used shall be insulation class 'A'.

(vi) TRANSFORMER TAPPINGS

The transformer shall be provided with an On load Auto tap changer (AVR) and RTCC switch with taps set for +5% to -15% in steps of 1.25% on H.V. side so as to give a constant voltage on L.V. side.

(vii) TRANSFORMER CHARACTERISTICS

The no load voltage ratio of the transformer shall be 11000/433 volts and the percentage impedance shall not exceed 5% or as per IS.

(viii) TRANSFORMER TERMINATIONS

The transformer shall have self supporting cable boxes with suitable glands and cable sockets for receiving 11,000 volt grade XLPE cables on the H.V. side as required.

On the MV side the transformer shall have a suitable self supporting terminal arrangement with extended busbars to receive 1100 volt grade PVC insulated and sheathed aluminium conductor armoured cable as specified.

(ix) TEMPERATURE RISE PARAMETERS

Thermistor sensors shall be embedded in the low voltage winding for warning and tripping, for temperature control. The temperature detectors shall be suitable for 24 volts D.C. The temperature rise when continuously operated of windings by resistance method shall not exceed 20 deg C over 50 deg C ambient for warning and 45 deg C over 50 deg C ambient for tripping.

(x) TRANSFORMER FITTINGS

The transformer alongwith OLTC shall be manufactured in accordance with the requirements as specified in the Standards stated above and shall be fitted with :

1. Diagram and Rating plate
2. Lifting Lugs.
3. Two earthing terminals on either side of the tank.
4. Four bidirectional rollers on the under carriage for movement.
5. Winding Temperature Indicator with alarm contacts for alarm and trip circuits.
6. Externally operated tapping switch with position indicator & locking arrangement.
7. Terminal marking plate.
8. Jacking Lugs.
9. H.V. cable box for 3 core XLPE cable as required.
10. L.V. cable box suitable for reception of XLPE armoured cables as required.
11. Oil conservator with drain plug.
12. Oil filling hole and cap.
13. Filter valve with plug.
14. Drain valve with plug or cover plate.

15. Oil level indicator with minimum marking.
16. Dehydrating breather (Silica gel breather)
17. Air release valve.
18. Explosion vent.
19. Thermometer pocket with plug.
20. 150 mm dial type contact thermometer with maximum temperature indicator and alarm and trip contacts for oil temperature.
21. Buchholz relay of double float type with alarm and trip contacts and M.S. box for terminating control cables of 4 x 2.5 sq. mm. size.
22. L. V. Neutral bushing
23. Shut-off valve between Buchholz relay and conservator.

The transformer shall be complete with the first filling of insulating oil as per IS 335 - 1983 including makeup fill at site.

(xi) TRANSFORMER GUARENTEED TECHNICAL PARTICULARS

The following guaranteed technical particulars of the transformer shall be furnished.

- a) Core loss
- b) Load loss
- c) Percentage Impedance

(xii) TRANSFORMER TESTING

Prior to acceptance and dispatch of the transformer, the owner reserves the right to witness the routine tests at manufacturers works. The transformer shall be subjected to the following routine tests as per relevant Standards at the manufacturers Works. The test certificates shall be submitted to the Owners/Architects for approval prior to dispatch. Except type test.

- a) Measurement of Winding Resistance
- b) Ratio polarity and phase relationship
- c) No load and load losses
- d) Impedance voltage
- e) No load and load current
- f) Insulation resistance
- g) Induced over voltage withstand
- h) Separate source voltage withstand

In addition type test certificate for following parameters shall also be submitted to Owners / Architects for record. Any type test if specifically asked for by Owners shall be carried out on the equipment covered by this contract shall be done at extra cost prior to dispatch.

- a) Temperature Rise
- b) Impulse voltage withstand.

(xiii) INSTALLATION

The transformer shall be installed as per the manufacturers instruction manual and shall conform to the requirements of IS 10028 : 1981.

Transformer and all other accessories shall be handled carefully in its upright position as indicated on the packing cases. Lifting lugs and jacking pads shall be use for lifting the transformer. Utmost care shall be taken in proper application of jacks. Where transformer is dragged or pulled on sleeper or rollers, the traction eyes provided at the bottom frame shall be used with suitable wire ropes and shackles.

Transformer shall be mounded on concrete plinth/foundation prepared for the purpose. Rollers shall be checked and locked to prevent movement of the transformer after being positioned after on the plinth.

The transformer cable end boxes shall be sealed to prevent entry of moisture.

The transformer neutral and body earthing shall be as per the requirements of IS 3043-1966 and the Local Inspecting Authorities

(xiv) COMMISSIONING TESTS

The following tests shall be carried out prior to commissioning at site by third party

- a) Insulation resistance of the winding between phases and phase and earth on the H.T. side.
- b) Winding resistance of all the windings on all tap positions.
- c) Voltage ratio test shall be carried out by applying low voltage on H.T. side and measuring the voltage between phases and phase and neutral on the L.T. side for every tap setting.
- d) On commissioning of the transformer the following readings shall be taken
 - MV side voltages at all tap settings
 - Temperature rise under no load conditions
- e) Transformer oil test
- f) If necessary, the transformer shall be heated by applying low voltage on the HT side and shorting the LT side. This shall be done for a period of 48 hours or till all the moisture has been removed from the transformer.

4. AUXILIARY EQUIPMENT FOR SUB-STATION:

Battery Charger Unit

i General

The battery charger shall be Float cum Boost type Thyristor controlled. The charger shall have selector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

ii. Construction Feature

Float cum Boost charger and DC Distribution Board shall be housed in sheet steel cubicle with panels of 1.6 mm thickness, louvers for ventilation glands plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens grey shade RAL-7032. The battery charger is divided into two compartments. The upper compartment houses the battery charger with all the necessary controls. The lower compartment is suitable for housing the batteries.

iii. Performance

The D.C output voltage of Float / Boost charger shall be stabilized within + 2% for AC input variation of 230 V + 10%, frequency variation of 50 Hz + 5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response SCR control. The ripple content will be within 3% of DC output nominal voltage.

There shall be provision to select Auto Float / Manual Float / Manual Boost modes. During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to Float Mode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the output volts by separate potentiometers.

The battery charger shall have automatic output current limiting feature.

iv. Components

The battery charger shall essentially comprise of the following

- 1 No. double pole ON/OFF MCB at AC input.
- 1 No. pilot lamp to indicate charger ON.
- 1 No. Main Transformer : Double wound, naturally air cooled, having copper winding.
- 1 set single phase full wave bridge rectifier consisting of 2 Nos. diodes and 2 Nos. SCRs, liberally rated, mounted on heat sinks and complete with resistor / condensor network for surge suppression.
- 1 No. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.
- 1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at + 2% of time set value for AC input voltage variation of 230 V + 10%, frequency variation of + 5% from 50 Hz and simultaneous load variation of 0-100% and also complete with Current Limiting Circuit to drop the Float Charger output voltage upon overloads to enable the battery to take over.
- 1 No. electronic controller to automatically changeover battery charging from boost to float and vice versa.
- 1 No. DC ammeter and toggle switch to read charger output current and battery charge / discharge current.
- 1 No. moving coil DC voltmeter to read the DC output voltage.
- 2 set potentiometer to adjust the output voltage during manual /auto float and boost modes.
- 1 No. double pole ON/OFF MCB for Charger Output (24 V DC Rating).
- 2 set DC output terminals. 1 set for the load and the other set for the battery.

Alarm Annunciation : Visual and audible alarm with manual accept reset facility shall be provided for the following :

- a. AC mains fail
- b. Charger Fail
- c. Load / Output over volt.

Rating

AC Input	:	230 V + 10% AC 50 Hz single phase.
DC Output	:	To float / boost charge 24 V / 200 AH batteries and also supply a continuous load.
Current Rating	:	30.0 Amps
Float Mode	:	27.0 V nominal (Adjustable) between 24-28.0 V.
Boost Mode	:	28.2 V nominal (Adjustable) between 24-29.0 V.
Voltage Regulation	:	+ 2% for AC input variation of 230 V + 10%. Frequency Variation of 50 Hz + 5% and DC load variation 0-100%
Ripple	:	Less than 5%

v. DC Distribution Board

It shall be provided in the charging cubicle, it will comprises of the following:

Incoming	:	1 No. 63 A DP MCB
Outgoing	:	10 Nos. 16 A DP MCB

SAFETY EQUIPMENT

DANGER PLATE

Danger plate shall be provided on HV and MV equipment. MV danger notice plate shall be 200 mm x 150 mm made of mild steel atleast 2 mm thick with vitreous enameled white on both side and with inscription in red colour on front side.

FIRE EXTINGUIHERS

Portable CO₂ conforming to IS:2878-1976, and dry chemical conforming to IS:2171-1967 shall be provided in the Sub-station.

RUBBER MATS FOR ELECTRICAL PURPOSE

Materials : Mats shall be of vulcanized rubber compound free from fabric insertions and fibrous materials.

The upper surface shall have ribbles or any other pattern, the thickness shall not be less than 6.5 mm at the root of the pattern.

The material shall be free from blisters, pin holes, cracks, embedded foreign matters and other defects.

SECTION V- LT SWITCHBOARDS

1. GENERAL

This section covers specification of LT Switchboards

2 STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2005, National Electric Code 1985, Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 - 1988 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

IS/IEC 60947 :Low Voltage switchgear & controlgear

- Part I : General rules
- Part II : Circuit Breakers
- Part III : Switches, disconnectors Switch disconnectors and fuse combination units
- Part IV : Contactors and Motor starters
- Part V : Control circuit devices and switching elements

IS 11353 : 1985 : Marking of Switchgear busbars

IEC 60529 : Degree of Protection of Enclosures for low voltage switchgear.

IS 3231 : 1986 : Electrical relays for power system protection

IS 10118 : 1982 : Code of Practice for selection, installation and Maintenance of switchgear & controlgear

IS 2551 : 1982 : Danger notice plates

3. LT SWITCHGEAR

(i) AIR CIRCUIT BREAKER

The ACB shall conform to the requirements of IEC 60947-2 & 3 (FOR SWITCH DISCONNECTION) / IS 13947-2 and shall be type tested & certified for compliance to standards from–CPRI, ERDA/ any accredited international lab. The circuit breaker shall be suitable for 415 V + 10%, 50 Hz supply system. Air Circuit Breakers shall be with moulded housing flush front, draw out type and shall be provided with a trip free manual operating mechanism or as indicated in drawings and bill of quantities with mechanical "ON" "OFF" "TRIP" indications.

The ACB shall be 3/ 4 pole with modular construction, draw out, manually or electrically operated version as specified. The circuit breakers shall be for continuous rating and service short Circuit Breaking capacity (Ics) shall be as specified on the single line diagram and should be equal to the Ultimate breaking capacity(Icu) and short circuit withstand values(Icw) for 1 sec.

Circuit breakers shall be designed to 'close' and 'trip' without opening the circuit breaker compartment door. The operating handle and the mechanical trip push button shall be at the front of the breakers panel. Inspection of main contacts should be possible without using any tools.

The ACB shall be provided with a door interlock. i.e. door should not be open when circuit breaker is closed and breaker should not be closed when door is open. However, door interlock should have defeat mechanism for On line testing of ACB

All current carrying parts shall be silver plated and suitable arcing contacts with proper arc chutes shall be provided with to protect the main contacts. The ACB shall have double insulation (Class-II) with moving and fixed contacts totally enclosed for enhanced safety and in accessibility to live parts. All electrical closing breaker shall be with electrical motor wound stored energy spring closing mechanism with mechanical indicator to provide ON/OFF status of the ACB.

The auxiliary contacts blocks shall be so located as to be accessible from the front. The auxiliary contacts in the trip circuits shall close before the main contacts have closed. All other contacts shall close simultaneously with the main contacts. The auxiliary contacts in the trip circuits shall open after the main contacts open. Minimum 4 NO and 4 NC auxiliary contacts shall be provided on each breaker. Rated insulation voltage shall be 1000 volts AC.

ACB shall confirm compliance to ROHS/WEEE guidelines.

(ii) CRADLE

The cradle shall be so designed and constructed as to permit smooth withdrawal and insertion of the breaker into it. The movements shall be free from jerks, easy to operate and shall be on steel balls/rollers and not on flat surfaces.

There shall be 4 distinct and separate position with self locking arrangement of the circuit breaker on the cradle.

Racking Interlock in Connected/Test/Disconnected Position.

Service Position : Main Isolating contacts and control contacts of the breaker are engaged.

Test Position : Main Isolating contacts are isolated but control contacts are still engaged.

Isolated Position : Both main isolating and control contacts are isolated.

There shall be provision for locking the breaker in any or all of the first three positions.

The following safety features shall be incorporated :

- Withdrawal or engagement of Circuit breaker shall not be possible unless it is in open condition.
- Operation of Circuit breaker shall not be possible unless it is fully in service, test or drawn out position.
- All modules shall be provided with safety shutters operated automatically by movement of the carriage to cover exposed live parts when the module is withdrawn.
- All Switchgear module front covers shall have provision for locking.
- Switchgear operating handles shall be provided with arrangement for locking in 'OFF' position.

(iii) PROTECTIONS

The breaker should be equipped with micro-controller based release to offer accurate and versatile protection with complete flexibility and shall offer complete over current protection to the electrical system in the following four zones

- Long time protection.
- Short time protection with intentional delay.
- Instantaneous protection.
- Ground fault protection.

The protection release shall have following features and settings:

a. True RMS Sensing

The release shall sample the current at the rate of 16 times per cycle to monitor the actual load current waveform flowing in the system and shall monitor the true RMS value of the load current. It shall take into account the effect of harmonics also.

b. Thermal Memory

When the breaker shall reclose after tripping on overload, then the thermal stresses caused by the overload if not dissipated completely, shall get stored in the memory of the release and this thermal memory shall ensure reduced tripping time in case of subsequent overloads. Realistic Hot/Cold curves shall take into account the integrated heating effects to offer closer protection to the system.

c. Defined time-current characteristics :

A variety of pick-up and time delay settings shall be available to define the current thresholds and the delays to be set independently for different protection zones thereby achieving a close-to-ideal protection curve.

d. Trip Indication

Individual fault indication for each type of fault should be provided by LEDs for faster fault diagnosis.

e. Self powered

The release shall draw its power from the main breaker CTs (hog slay type) and shall require no external power supply for its operation.

f. Zone Selective Interlocking

The release shall be suitable for communication between breakers to enable zone selective interlocking. This feature shall be provided for both short circuit and ground fault protection zones to offer total discrimination between breakers. This feature enables faster clearance of fault conditions, thereby reducing the thermal and dynamic stresses produced during fault conditions

and thus minimizes the damage to the system. To implement ZSI manufacturer should supply all related equipment like power supply, wiring etc.

On-Line change of settings should be possible. It should be possible to carry out testing of release without tripping the breaker.

- g The release shall meet the EMI / EMC requirements.
- h **Deraing factor**- These shall not any derating up to 50 degree. Manufactures shall provided the derating table/chart
- i 4P ACB shall have 100% Neutral as same of Phase conductor with protection setting (setting of 50%,100% and Off)
- j ACB release shall have 1st –ON/OFF setting to co-ordinate with HT breakers.
- k ACB release shall have inbuilt “Auto protection”against excessive heating at terminals.
- l Combined accuracy (Sensor + Release) $\leq 1.5\%$ as per IEC 61557-
- m . The setting range of release shall be as follows as per SLD :

The release should provide local indication of actual %age loading of individual phase at any instant. The release should be able to communicate on MODBUS RTU protocol using inbuilt RS485 port and shall be integral part of supply with trip unit. Parameters of the Protection Release should be changeable from Release as well as thru communication network. Release thru dial type potentiometer and navigation keys & should have graphical LCD for display of power parameters. The release should provide comprehensive metering as per mentioned in SLD

(iv) SAFETY FEATURES

- The safety shutter shall prevent inadvertent contact with isolating contacts when breaker is withdrawn from the Cradle.
- It shall not be possible to interchange two circuit breakers of two different thermal ratings. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.
- There shall be provision of positive earth connection between fixed and moving portion of the ACB either thru connector plug or sliding solid earth mechanism. Earthing bolts shall be provided on the cradle or body of fixed ACB.
- The incoming panel accommodating ACB shall be provided with indicating lamps for ON-OFF positions, digital voltmeter and ammeter of size not less than 96 mm x 96 mm, selector switches, MCB for protection circuit and measuring instrument circuits.
- It shall be possible to bolt the drawout frame not only in connected position but also in TEST and DISCONNECTED position to prevent dislocation due to vibration and shocks.

- Drawout breakers should not close unless in distinct Service/Test/Isolated positions.
- The insulation material used shall conform to Glow wire test as per IEC60695.
- The ACB shall provide in built electrical and mechanical anti-pumping.
- All EDO ACB`s Shall have Ready to Close Contact to ensure that the ACB gets a command only when it is ready to close for applications of Remote Control, AMF, Synchronization and Auto Source Change Over Systems.

SECTION VI- RISING MAINS/ BUSDUCT (SANDWICHED CONSTRUCTION)

1. Scope:

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type busbar trunking for use as feeder busbars for interconnection between separate electrical equipment / load centers, and for use as plug in busbar risers.

2. System details:

The busbar shall be suitable for operation in a 1000V system, with frequency of 50 Hz having 100% neutral and internal earth.

3. Standards:

The busbar shall be designed and manufactured in accordance with the following international standards for busbar trunking:

- BS 5486 Part 2 : Particular requirements of busbar trunking systems
- IEC 60439 –2 : Particular requirements of busbar trunking systems
- IEC 60529 : Degree of protection

The bus duct shall conform to IEE/NEMA/BUI/JIS for seismic protection certification.

4. Design & Construction requirements – Sandwich busbars

General: The busbars shall be of sandwich construction, non-ventilated design. It shall be possible to mount the busbar system in any orientation, without affecting the current rating.

Busbars: : The busbars shall of high conductivity Aluminum bars with conductivity > 61%.

The maximum hotspot temperature rise at any point in the bus duct at continuous rated load shall not exceed 35 deg.C above a maximum ambient temperature of 45 deg.C in any position.

Busbar shall be suitably plated at all joints and contact surfaces.

Busbar shall be tinned plated for low contact resistance.
Busduct system shall be terminated by end enclosure.

Unless otherwise highlighted, full size neutral of the same cross-sectional area as the phase conductor shall be provided for all rating of the busbar system.

Where an earth conductor is required, it shall be a separate, integral earth conductor, of the same high conductivity material as the phase conductors.

Insulation:

The busbars shall be insulated throughout their length by epoxy coating / Polyester / Mylar. The insulation material used shall be of Class F (155 deg .C) / Class H (180 deg. C). The insulation must comply to UL 94 V-O.It shall be Halogen Free.

Housing:

The housing shall be made of 1.6 mm galvanized sheet steel, with an epoxy powder coated paint finish. The housing shall be profiled, to provide higher strength and efficient heat dissipation. The width of the housing shall preferably be the same for all ratings of busbars, in order to provide interchangeability of tap off boxes.

Joints:

The joints between sections shall be made so as to provide flexibility during installation and expansion / contraction of busbar during operation. The joints shall be of the single bolt type

The joint construction must have the following features.

- Heat expansion of at least 3mm per joint.
- The joint insulation must be of one piece molded design and not have any cut edges which can absorb moisture.
- The joint construction must allow a +/- 14mm adjustment at the time of installation, for ease of adjusting to site measurement variations.
- The joint bolt must be insulated with a bolt insulator. The bolt insulator must be of molded one piece.
- The joint system must be designed in a way that the installer cannot insert the busduct length too far and damage the bolt insulator.
- The busbar ends shall not have holes or slots at the joints – the electrical continuity shall be through pressure plates, achieving a high area of joint cross section and expansion capability.
- It shall be possible to install and remove the joints without disturbing the busbar run.

Tapoff units:

Where specified, tap off locations shall be provided for insertion of plug in tap off units. The tap off locations shall be covered by hinged plates.

Tap off units safety features:

- When the door cover is open, it should not be possible to turn the MCCB on. This should be by means of mechanical safety locking system and not by the rotary handle of the MCCB.
- The door shall be provided with a lock and keys.
- When the lever is in 'on' position, even with the key unlocked, the operator should not be able to remove the box or open the tap off location cover.
- During insertion, the earth conductor shall make contact first before the phase conductors. This should follow the sequence of first in last out concept.
- The tap off unit handle shall be flexible in the sense that the 'on/off' handle can be attached to at the front or left or right side of the box, depending on the site situation.

- When the box is open the live conductors shall be safe guarded by a transparent insulator plate which allows for visible inspection but does not allow touching of the live conductors.
- In the event of a MCCB requiring maintenance or changing, the mechanical interlocking must allow easy access by removing only the front plate and not interrupting the adjacent linkages.
- For IP65 bus-trunking, the tap off unit arrangement also must achieve IP65 without requiring any additional sealing at site. The complete arrangement with the tap off unit shall be tested for IP rating by an independent test authority.
- The tap off boxes will be suitable for accommodating MCCBs or other accessories, as required. The tap off units should allow the flexibility of accommodating different, reputed MCCB makes, to be mutually agreed depending on the tender requirements.

Accessories:

Bus trunking system shall be complete with all accessories like bends, busduct, expansion joints, flexible connections etc... to suit site requirements. Rising main in addition shall be complete with tap off points, end feed units, end covers, thrust pads and spring hangers at each floor. Bus trunking systems shall be complete in all respects whether any item is individually listed in Schedule of Quantities or not. All accessories shall be deemed to be included in the unit rate of straight length of the busduct and rising mains.

Thrust Pads

Thrust Pads shall be provided in the raising main systems for necessary support to the rising mains and to prevent busbar expansion in down ward direction

5. TESTING AT MANUFACTURERS WORKS

The Rising Mains and Bus Ducts shall be tested in accordance with IEC 60439-2 : 2000 and the related test certificate shall be from an national / international recognized test house / authority or carried out and witnessed at manufactures premises.

6. INSTALLATION

- Installation of the Rising Main shall be carried out as per manufacturers instruction.
- For Bus Duct horizontal runs, a horizontal expansion units shall be provided at every 40 m if required by design and at expansion joints of the building structure and the system shall be supported at every 1.5 m
- Annular space around Rising Mains and/or Bus Ducts while crossing floors and walls shall be filled up by sealing material made available by Engineer-in-charge in accordance with manufacturers instruction.

7. TESTING AT SITE

- Physical check including checking damage/cracking in any components, tightness of bolts and connections etc.
- Insulation test after installation according to manufacturers test procedures.
- Testing earth continuity.

SECTION – XI : MEDIUM VOLTAGE 1.1 KV GRADE XLPE INSULATED PVC SHEATHED CABLES

1. SCOPE

The MV cables shall be supplied, inspected, laid, tested and commissioned in accordance with drawings, Specifications, relevant Standard Specifications and cable manufacturer's instruction.

2. STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice as stipulated below shall apply to the equipments and the work covered in this section. In addition the relevant clauses of the Indian Electricity Act 1910, Indian Electricity Rules 1956, National Building Code 1994, National Electric Code 1985, Code of Practice for Fire Safety of Building (general) : General Principal and Fire Grading – IS 1641 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

PVC insulated heavy duty cables	IS 1554 - 1988
Cross link polyethylene insulated PVC (sheathed XLPE cables)	IS 7098 - 1985
Code of practice for installation and maintenance of power cables	IS 1255 - 1983
Conductors for insulated electrical cables	IS 8130 - 1984
Drums for electrical cable	IS 10418-1982
Methods of test for cables	IS 10810-1988
Recommended current rating	IS 3961 - 1987
Recommended short circuit rating of high voltage PVC cables	IS 5891 - 1970

3. MATERIAL

The MV cables shall be cross linked polyethylene (XLPE) insulated PVC sheathed of 1100 volts grade as asked for in the schedule of quantities. **Cables upto 16 sq.mm shall be with copper conductor and 25 sq.mm and above shall be with aluminium conductor.**

(i) TECHNICAL REQUIREMENTS:

- a) All XLPE Aluminium/Copper Power cables shall be 1100 Volts grade, multi core constructed as per IS : 7098 Part-I of 1988 as follows :
 - Stranded Aluminium /Copper conductor in case of 10 sq.mm. and above and solid conductor in case of 10 sq.mm. and below.
 - Cores laid up
 - The inner sheath should be bonded over with thermo-plastic material for protection against mechanical and electrical damage.
 - Armoring should be provided over the inner sheath to guard against mechanical damage. Armoring should be Galvanized steel wires or galvanized steel strips. (In single core cables used in A.C. system armoring should be non-magnetic hard aluminium Wires/Strips. Round steel wires should be used where diameter over the inner sheath does not exceed 13 mm; above 13 mm flat steel armour should be used. Round wire of different sizes should be provided against specific request.)

- The outer sheath should be specially formulated heat resistant black PVC compound conforming to the requirement of type ST2 of IS : 5831-1984 extruded to form the outer sheath.
- b) Conductor shall be of electrolytic Aluminium/Copper conforming to IS : 8130 and are compact circular or compact shaped.
- c) Insulation shall be of XLPE type as per latest IS general purpose insulation for maximum rated conductor temperature 70 degree centigrade.
- d) In Inner sheath laid up cores shall be bonded over with thermoplastic material for protection against mechanical and electrical damage.
- e) Insulation, inner sheath and outer sheath shall be applied by extrusion and lapping up process only.
- f) Armouring shall be of galvanized steel wire/flat.
- g) Repaired cables shall not be used.
- h) Current ratings of the cables shall be as per IS : 3961.
- i) The XLPE insulated cables shall conform to latest revision IS read along with this specifications. The Conductor shall be stranded Aluminium/Copper circular/ sector shaped and compacted. In multi core cables the core shall be identified by red, yellow, blue and black coloring of insulation.
- j) The XLPE insulated 1100 Volts grade power cables shall conform to latest IS and shall be suitable for a steady conductor temperature of 70 degree centigrade. The conductor shall be stranded Aluminium/Copper as called for in the Schedule of quantities. The outer sheath shall be as per the requirement of type ST-2 of IS:5831 of 1984.
- k) The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
- l) Progressive automatic in line sequential marking of the length of cables in meters at every one meter shall be provided on the outer sheath of all cables.
- m) Cables shall be supplied in non returnable wooden drums as per IS : 10418. Both ends of the cables shall be properly sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation, storage and erection.
- n) The product should be coded as per IS :- 7098 Part-I as follows :-

Aluminium Conductor	A
XLPE Insulation	2X
Steel round wire armour	W
Steel strip armour	F
Steel Double round wire armour	WW
Steel Double strip armour	FF
Non-magnetic (Al.) round wire armour	Wa
Non-magnetic (Al.) strip armour	Fa
PVC outer sheath	Y

4. INSPECTION

All cables shall be inspected by the contractor upon receipt at site and checked for any damage during transit.

5. JOINTS IN CABLES

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. This apportioning shall be got approved by the Owner's site representative before the cables are cut to lengths. Where joints are unavoidable heat shrinkable type joints shall be made. The location of such joints shall be got approved from the Owner's site representative and shall be identified through a marker.

6. JOINTING BOXES FOR CABLES

Cable joint boxes shall be installed with heat shrinkable sleeve and of appropriate size, suitable for XLPE armoured cables of particular voltage rating.

7. JOINTING OF CABLES

All cable joints shall be made in suitable, approved cable joint boxes and the filling in of compound shall be done in accordance with manufactures' instructions and in an approved manner. All straight joints shall be done in epoxy mould boxes with epoxy resin.

All cables shall be joined colour to colour and tested for continuity and insulation resistance before jointing commence. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged. The conductors shall be efficiently insulated with high voltage insulating tape and by using of spreaders of approved size and pattern. The joints shall be completely topped up with epoxy compound so as to ensure that the box is properly filled.

8. CABLE TERMINATIONS

Cable termination shall be done in cable terminal box using crimping sockets and proper size of glands of double compression type with earthing facility.

9. BONDING OF CABLES

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armour clamp and gland. The clamps must grip the armouring firmly to the gland or casing, so that no undue stress is passed on to the cable conductors.

10. LAYING OF CABLES

10.1 ON CABLE TRAYS

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimize stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks. The relative position of the cables, laid on the cable tray shall be preserved and the cables shall not cross each other. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius as recommended by the manufacturer's. All cables shall be laid with minimum one diameter gap and shall be clamped at every metre to the cable tray and shall be tagged for identification with aluminum tag and clamped properly. Tags shall be provided at both ends and all changes in directions both sides of wall and floor crossings. All cable shall be identified by embossing on the tag the size of the cable, place of origin and termination.

All cables passing through holes in floor or walls shall be sealed with fire retardant Sealant and shall be painted with fire retardant paint upto one meter on all joints, terminations and both sides of the wall crossings by "VIPER CABLE RETARD".

10.2 IN GROUND

The minimum width of trench for laying single cable shall be minimum 350 mm. Where more than one cable is to be laid in horizontal formation, the width of the trench shall be workout by providing 200 mm gap between the cables, except where otherwise specified. There shall be clearance of 150 mm between the end cable and

the side wall of the trench. The minimum dept of the cable trench shall not be less than 750 mm for single layer of cables. When the cables are laid in more than one tier the depth of the trench shall be increased by 300 mm for each additional tier.

Excavation of trenches : The trenches shall be excavated in reasonably straight lines. Wherever there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual. The excavated soil shall be stacked firmly by the side of the trench such that it may not fall back into the trench. The bottom of the trench shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 100 mm in depth. Prior to laying of cables, the cores shall be tested for continuity and insulation resistance. The cable drum shall be properly mounted on jacks, at a suitable location, making sure that the spindle, jack etc. are strong enough to carry the weight of the drum and the spindle is horizontal. Cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains. The entire drum length shall be laid in one stretch. However, where this is not possible the remainder of the cable shall be removed by 'Flaking' i.e. by making one long loop in the reverse direction. After the cable has been uncoiled and laid into the trench over the rollers, the cable shall be lifted off the rollers beginning from one end by helpers standing about 10 meters apart and laid in a reasonably straight line. Cable laid in trenches in a single tier formation shall have a cover of clean, dry sand of not less than 150 mm. above the base cushion of sand before the protective cover is laid. In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 300 mm shall be provided over the initial bed before the second tier is laid. Finally the cables shall be protected by second class bricks before back filling the trench.

Back Filling : The trenches shall be back filled with excavated earth free from stones or other sharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 300 mm. Unless otherwise specified, a crown of earth not less than 50 mm in the centre and tapering towards the sides of the trench shall be left to allow for subsidence.

11. CABLES INSIDE BUILDING

Cables inside buildings shall be laid on the cable trays. All cables passing through walls shall run through GI Pipes of adequate diameter 50 mm apart maintaining the relative position over the entire length.

12. ROUTE MARKER

Route marker shall be provided along straight runs of the cables not exceeding 100 meters also for change in the direction of the cable route and underground joints. Route marker shall be of cast iron painted with aluminum paint. The size of marker shall be 100 mm dia with "Cable" and voltage grade inscribed on it.

SECTION – VII: LIGHT FIXTURES

1. SCOPE

Scope of work under this section shall include inspection at suppliers/manufacturer's premises at site, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories including all necessary supports, brackets, down rods and painting etc as required.

2. LIGHTING FIXTURES & ACCESSORIES

The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Project Manager.

3. STANDARDS

The lighting and their associated accessories such as lamps, reflectors, housings, ballasts etc., shall comply with the latest applicable standards, more specifically the following:

General and safety requirements for Luminaries :

Part-1 Tubular fluorescent lamps	- IS – 1913 (Part-1)
Industrial lighting fittings with metal reflectors	- IS - 1777
Decorative lighting outfits	- IS - 5077
Bayonet lamp holders	- IS - 1258
Bi-pin lamp holders for tubular fluorescent lamps	- IS - 3323
Electronic Ballasts for fluorescent lamps – General & Safety requirement	- IS–13021 (Part-1)
Electronic Ballasts for fluorescent lamps – Performance requirement	- IS–13021 (Part-2)
Ballast for HP MV lamps	- IS - 6616
Tubular Fluorescent lamps	- IS-2418 (Part-1 to 4)
Luminaries – General requirement	- IS – 10322 (Part-1)
Luminaries – Constructional requirement	- IS – 10322 (Part-2)
Luminaries – Screw and Screw less termination	- IS – 10322 (Part-3)
Luminaries – Methods of Tests	- IS – 10322 (Part-4)
Particular requirement – General purpose Luminaries	- IS-10322 (Part-5/Sec-1)
Particular requirement – Recessed Luminaries	- IS-10322 (Part-5/Sec-2)
Particular requirement – Luminaries for Road and Street lighting	- IS-10322 (Part-5/Sec-3)
Particular requirement – Portable General purpose Luminaries	-IS-10322(Part-5/Sec-4)
Particular requirement – Flood Lighting	-IS-10322 (Part-5/Sec-5)
High pressure mercury vapour lamps	-IS-9900 (Part-1)
Tungsten filament general electric lamps	-IS- 418

4. LIGHT FITTINGS-GENERAL REQUIREMENTS

- a). Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in lamp life or without deterioration of materials and internal wiring. Degree of protection of enclosure shall be IP-65 for outdoor fittings except bulkhead fitting. Bulkhead fitting shall be provided with IP-54 protection.
- b). Fittings shall be so designed as to facilitate easy maintenance including cleaning, replacement of lamps/ ballasts.
- c). All fittings shall be supplied complete with lamps. All mercury vapour and sodium vapour lamp fittings shall be complete with accessories like ballasts, power factor improvement capacitors, starters, etc. Out door type fittings shall be provided with weather proof junction boxes (IP-55) and IP-54 Control gear boxes.
- d). Each fitting shall have a terminal block suitable for loop-out connection by 1100 V PVC insulated copper conductor wires upto 4 sq.mm. the internal wiring should be completed by the manufacturer by means of standard copper wire and terminated on the terminal block.
- e). All hardware used in the fitting shall be suitably plated or anodized and passivated.
- f). Earthing : Each lighting fitting shall be provided with an earthing terminal. All metal or metal enclosed parts of the housing shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity throughout the fixture.
- g). Painting/Finish : All surfaces of the fittings shall be thoroughly cleaned and degreased and the fittings shall be free from scale, rust, sharp-edges, and burns.
- h). The housing shall be powder coated/stove-enameled or anodized as required. The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 12 mm dia mandrel.
- i). Metal used in BODY of lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specification of standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burns and tool marks. Solder shall not be used as mechanical fastening device on any part of the fixture.

5. LIGHT FITTINGS – SPECIAL REQUIREMENTS

Box Channel Type Industrial Fittings

Box type slim line channel must be in screwless construction manufactured from M.S. CRCA sheet steel powder coated with MS CRCA cover, powder coated white. Light reflection surface in Box/Channel type fittings shall be in a POLYESTER PRECOATED STEEL having a reflection factor of not less than 80%. SCREWLESS DESIGN & CONSTRUCTION Light fixtures shall be preferred due to their ease of maintenance, especially for box/channel for box/channel type fixtures.

Moisture Proof Industrial Fittings

Surface mounted totally enclosed moisture proof fixtures must be in polycarbonate body and diffuser with transparent prismatic interior and smooth exterior and frosted end. Fixture must be completely sealed with polyurethane double gasket to achieve IP 65 protection. Fixture is complete with CRCA steel white powder coated / enameled finish reflector.

18 W / 36 W Fluorescent and 36 W CFL Low Glare Light Fittings

Recessed mounted, modular fluorescent lighting fixture made of CRCA Sheet steel powder coated (white) housing, electro chemically brightened and anodized reflector, three dimensional cross louvers with concave contours, fresnel top at louver saddle to increase efficiency. The luminance of <math><200 \text{ cd/M}^2</math> at 63 degree viewing angle in all directions so as to confirm Cat-2 classification of CIBSELG3

Highbay Industrial Fittings

Industrial Highbay luminaries shall be provided with pressure die cast housing along with all accessories, orthocyclically wound opien construction ballast, capacitor & semi parallel igniter connected to terminal block and mounted on the gear plate. The gear shall have side entry for ease in maintenance. The spun aluminium reflector is suitable for narrows well as wide beam distribution. The luminaries will be suitable for metal halide lamp HPI BU + 250 W which has 25500 lumens and 2.5 min re-strike time (when operate with son gear).

6. ACCESSORIES FOR LIGHT FITTINGS REFLECTORS

The reflectors shall be made of CRCA sheet steel/aluminium /Silvered glass/Chromium plated sheet copper as required. The thickness of reflectors shall be as per relevant standards. Reflectors made of steel shall have stove enameled/ vitreous enameled/epoxy coating finish. Aluminium used for reflectors shall be anodized/epoxy stove enameled /mirror polished. The finish for the reflector shall be as specified. The reflectors shall be free from scratches / blisters and shall have a smooth and glossy surface having optimum light reflecting coefficient. Reflectors shall be readily removable from the housing for cleaning and maintenance without use of tools.

7. LAMPS

TLD

Lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 5 mg. The lamp shall have minimum lumen maintenance of 85 and CRI of 85. The lamp must comply to ROHS (Restriction of Hazardous substances) and covered by WEEE. Lamp should be fully recyclable. The lamp should be low on maintenance with life of 40 K hours in case of electromagnetic ballast and 65 K hours in case of HF ballast up to 10% failure. The discharge glass shall be lead free.

TLD Lamps shall be minimum tri-phosphor type and have bi-pin bases.

The fluorescent Tubes (TLD) should have cool daylight colour designation. But Architects reserve the right to prescribe either Cool Daylight or Bright White or Incandescent Colour Designations for TLD. NO extra payment will be made over the quoted rate of bidder for this. The 36 W fluorescent tubes will have Nominal Luminous Flux of not less than 3350 lumens whether so mentioned in the Schedule of Quantities or not.

T 5 – HIGH EFFICIENCY ECO-FRIENDLY LAMPS

T-5 lamp shall be environment friendly low pressure mercury discharge lamp with mercury content less than or equal to 3 mg. lamp should have lowest CO2 emission compared to any other comparable light source (40% less than a TL-D standard lamp, 26% less than TL-D / 80). T-5 lamp shall be 100% lead free. T-5 lamp shall be designed for operation with electronic gear and well suited for dimming. Maximum lumen output to be reached at approx 35°C in free burning position. T-5 lamp can be ignited from -15°C to + 50°C. Lamp should be fully recyclable and must comply to ROSH (Restriction of Hazardous substances) and shall be covered by WEEE. T-5 shall have 16 mm in diameter service life of TL-5 lamp should be 10% more than TL-D lamps. T-5 lamp shall have lumen efficacy of upto 104 Lumen/ W and shall have excellent colour rendering to En 12464 (Ra 80 to 89).

COMPACT FLUORESCENT LAMP

Compact fluorescent lamp shall have same luminous flux and power consumption as fluorescent tubes but less than half the length and more compact than U-shaped and circulator lamps. CFL shall be suitable for use with conventional control gear & standers and for HF electronic control gear

8. HIGH FREQUENCY ELECTRONIC BALLAST

High frequency electronic ballast shall be used with fluorescent / Compact Fluorescent Lamps wherever specified in the schedule of quantities. High frequency electronic ballast shall comply to the following:

- IEC 927, IEC 928 for $\leq 10\%$ total harmonic distortion.
- EMI / RFI – Confirming to FCC / VDE Class A/B.
- Line Transient as per IEEE C62.41.
- Ballast Crest Factor C1.7%.
- No Stroboscopic Effect
- Constant Wattage / Light output between 240 V $\pm 10\%$.
- Circuit protection for surge current and inrush current.
- Short circuits, open lamp protection
- PF > 0.99 for fluorescent / T5 lamp and 0.95 for CFL.
- Deactivated lamp protection
- Suitable for use with single and twin lamps
- RFI < 30 MHz EN 55015
- Total Harmonic Distortion (THD) $\leq 10\%$
- Immunity to interference EN 61547
- Safety EN 60928 / IS 13021 (Part I)
- Performance EN 60929 / IS 13021 (Part II)
- Vibrations & Bump tests IEC 68-2-6 FC
IEC 9001
- Quality Standard ISO 9001
- Environmental Standard ISO 14001
- DC Operation EN 60924
- Emergency Lighting Operation VDE 0108

Total System consumption (lamps + ballast) for

- 1 x 36 W TLD, shall not exceed 36 W
- 1 x 28 W T-5, shall not exceed 28 W
- 1 x 35 W T-5, shall not exceed 35 W
- 1 x 14 W T-5, shall not exceed 14 W
- 1 x 18 W CFL, shall not exceed 18 W
- 1 x 36 W CFL, shall not exceed 36 W

SECTION – XIII : EARTHING

1. SCOPE

This section covers specifications for earthing systems comprising of earth electrodes, earth leads and loop earthing conductors.

Separate earthing systems shall be provided for neutral earthing (of transformers and generators) and body earthing.

All the non-current carrying metal parts of electrical installations including metal conduits, trunkings, cable armour, switchboards, DBs, light fittings and all other non current carrying parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system.

All three phase equipment shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

Separate earth leads of appropriate size shall be provided for.

- Main switchboards
- UPS system earth bus
- Computer system earth bus
- Telephone system earth bus

Wherever so specified the earth lead shall be PVC sheathed to provide a “clean” earth.

All metallic components and pipes within bathrooms, toilets and kitchens shall be connected to the earthing system by means of minimum 4 sq mm PVC insulated (green/yellow) copper conductor wires.

2. STANDARDS

The earthing system shall be carried out in conformity with the updated and current edition of IS 3043 : 1987. In addition, relevant clauses of Indian Electricity Act 2003, India Electricity Rules 1956 and IEE Wiring Regulations (16th edition), as amended upto date, shall also be applicable.

3. EARTH ELECTRODES

➤ **Plate Earth Electrodes**

The plate electrodes shall be of copper or GI as called for in the schedule of quantities. Minimum dimensions of the electrodes shall be 600 mm x 600 mm. Thickness of copper electrodes shall not be less than 3 mm and of GI electrodes not less than 6 mm.

➤ **Pipe Earth Electrode**

Pipe electrode shall be fabricated from a 40 mm dia 4500 mm long class B (medium) GI pipe. The GI pipe shall be tapered at the bottom and shall be provided with 12 mm dia holes drilled at every 75 mm.

➤ **Galvanizing**

Galvanizing of Earth Electrodes and Earthing Conductors shall conform to class – IV of IS 4736 : 1986.

4. EARTH PIT

(i) For plate electrodes

Plate electrode shall be buried in ground with its face vertical and top not less than 500 mm below ground level. The depth shall be increased if required so that permanently moist soil level is reached. The electrode shall be surrounded by alternate layers of charcoal and salt. A 20 mm dia class B GI pipe shall be provided for watering of the soil surrounding the electrode. The watering pipe shall have a watering funnel attachment with a wire mesh which shall be housed in the masonry inspection chamber. Main earth lead shall be securely terminated at the electrode by means of 2 bolts, nuts, checknuts and spring washers. The earth lead from the electrode upto the test link in masonry chamber shall be drawn in a suitable diameter class B GI pipe for mechanical protection. The GI pipe shall be provided with a coat of bituminous paint or bituminized jute wrapping for additional corrosion protection. The lead shall terminate in a test link provided in the inspection chamber to enable the earth electrode to be isolated for measuring earth resistance.

(ii) For pipe electrodes

Pipe electrode shall be installed with its stop not less than 200 mm below ground level. The top shall be provided with a 40 mm x 20 mm reducer to fix watering funnel with mesh on top. The entire length of pipe below the inspection chamber shall be surrounded by alternate layers of charcoal and sand. Earth lead shall be provided as for plate electrode and shall be terminated using a though bolt, nuts, check nuts, spring washers etc.

(iii) Masonry inspection chamber

The watering funnel arrangement as also earth test links shall be accessible and shall be housed in a 400 mm x 400 mm x 400 mm deep masonry inspection chamber having a lockable 10 mm thick cast iron hinged cover plate attached to a galvanized steel frame work embedded in the chamber walls. The hinged cover shall be suitably marked on top so that it is conspicuously identifiable as an earth station.

(iv) Location of earth electrodes

Location of earth electrodes shall be based on following guidelines.

- Minimum distance between any electrode and building structure shall be 1.5 m.
- Minimum distance between two adjacent electrodes shall be 2 m.
- Electrodes shall be located in accessible locations. Entrances, pavements and roads shall not be used for locating earth electrodes.

5. EARTHING CONDUCTOR**(i) Main Earth Lead**

Interconnections between earth bus provided on the main switchboard inside the building for body earthing / neutral terminals of transformers / generators for neutral earthing and test link provided in the earth electrode inspection chamber shall be laid at minimum 300 mm depth below ground (minimum 600 mm below road crossings and paved pavements).

For small installations where this lead is by means of GI / copper wire, the earth lead shall be drawn in a 15 mm dia class B GI pipe. For larger installations the GI pipe size shall be suitable for drawing the earth strip. GI pipe shall be provided with a coat of bituminous paint on the outside for minimizing corrosion. In locations where GI pipe protection cannot be provided, the earth conductor shall be wrapped with bituminous jute wrapping.

(ii) Earthing conductors

Earthing conductors shall be connected to form the earthing network throughout the installation for earthing of all non-carrying metal parts as below. Materials and sizes shall be as per schedule of quantities

- Main earthing conductors shall be taken from the earth connections at the main switchboards to all other switchboards in the network.
- Sub-mains earthing conductors shall run from the main switchboard to the sub distribution boards and to the final distribution boards.
- Loop earthing conductors shall run from the distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board or to an earth leakage circuit breaker.
- Conduiting systems and cable armouring shall be earthed at the ends adjacent to switchboards at which they originate, or otherwise at the commencement of the run by separate loop earthing conductors in effective electrical contact with cable armour, switch boxes, accessories, lighting fitting etc.

(iii) Installation and Jointing of earthing conductors

- Earthing conductors shall be provided in longest possible unbroken length to minimize jointing of the conductors in between terminations.
- Strip conductors shall be secured to the building walls etc. with appropriate size of saddles at intervals not exceeding 900 mm. The saddle shall be gun metal for copper and GI for GI strips.
- Copper earth strips shall be jointed by butt welding /brazing or the mating surfaces shall be tinned, riveted and soldered.
- GI earth strips shall be jointed by GI bolts, nuts, checknuts and spring washers of appropriate size.
- All exposed joints shall be provided with 2 coats of anti corrosive paint.
- Wires shall be jointed by means of lugs of appropriate size connected by bolts, nuts, checknuts and washers. If the connection is on a painted surface, the paint shall be thoroughly removed and the metal exposed for making effective electrical contact. Lugs and bolts shall be of brass for copper wires and for GI wires.

6. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system.

7. RESISTANCE TO EARTH

No earth electrode shall have a greater ohmic resistance than 3 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be upto 5 ohms.

The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers, and shall not exceed 1 ohm.

8. Maintenance free Earthing Electrode System/ Chemical Earthing

In maintenance free earthing copper bonded earthing rod electrode shall be of minimum 14.35 mm in diameter and 3 meter length. The rod shall be placed in a 150

mm dia an augured hole in the ground and then surrounded by ground enhancement material in either a dry form or pre mixed in a slurry. Once set, ground enhancement material becomes hard and as such holds positively to the rod as well as surrounding ground. Earth rod offered shall have passed the test required of BS7430/ ANSI/ UL467 and confirm to the adhesion of the copper coating to the steel core (Design feature that prevents the ingress of moisture and subsequently the integrity of the rod).

Minimum 0.25 mm thickness of copper shall be deposited over the steel core as per BS 7430/ UL 467. Average life of the ground rod shall be 30 years in most soil.

Ground enhancement material shall be as per IEEE-80 clause 14.5d with a resistivity of less than 0.12 ohm-meter. The ground enhancement material shall be permanent and not leach any chemicals in to the ground.

Minimum 30 Kg of ground enhancement material shall provided for each earth electrode.

Inspection chamber shall be of 400 x 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint. 2 Nos. of 50 x 6 mm cross section & 300 mm long copper strip to be clamped with copper claded rod electrode have sufficient nos (But not less than 4 Nos.) of 10□ mm GI nuts & bolts for connection to the equipment / interconnection to the other pits to form equi-potential bonding.

9. TESTING AT SITE

(i) Testing Of Earth Continuity Path

The earth continuity conductor including metal conduits and metallic envelopes of cable in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

(ii) Earth Resistivity Test

Earth resistivity test shall be carried out in accordance with IS Code of Practice for earthing IS 3043.

SECTION – XIV : ESE LIGHTNING SURGE VOLTAGE PROTECTION SYSTEM (Based on NFC17-102)

1) Scope of Work

The work to be done under this section comprises the supply & installation necessary for the complete installation of the lightning protection system.

The design of the components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event.

The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The lightning protection system should complies in accordance with NFC 17-102 standard and shall be installed strictly to the manufacturer's instructions.

The advanced lightning protection system shall include components as follows:

ESE Air terminal
Mechanical supports
Down-conductors
Performance Recording Equipment
A low impedance Grounding system.

2. Standards

Complete installation shall be engineering and constructed in accordance with the latest revision of the following :

- NFC-17-102
- IEC 61204

The details of the lightning protection system shall also confirm to the requirements of all relevant local codes, as applicable, together with the additional requirements referred to in this specification and drawings, whichever is more stringent and acceptable to the engineer.

3. Air Terminal

The air termination shall be of the type that responds dynamically to the appearance of a lightning down leader by creating free electrons between outer surfaces and an earthed central finial rod.

The Air-terminal should work under **Early Streamer Emission (ESE) Technology** and the attractive radius of the air termination shall be traceable to known and acceptable lightning research and statistics.

The Lightning conductor should deliver a unique gain time in efficiency, anticipating the natural formation of an upward leader. The Air-terminal generates a leader that propagates rapidly to capture the Lightning stroke and conduct it towards the ground.

Arcing is not to be continuous and shall only occur during the progress of the lightning leader.

The air termination shall not cause high frequency radio interference except during the millisecond intervals associated with the progress of the lightning leader and during the main return strike of lightning events in the region.

The materials of the air termination shall be non-corroding in normal atmosphere.

The air termination shall not be dependent upon batteries or external power supplies for any part of its operation. The Height of the air terminal support mast should be minimum 2mts and the height will be increased as per the coverage design. The support shall be securely installed and guy wires shall be used where necessary to enable the air termination and mast system to withstand maximum locally recorded wind velocities.

4. Down Conductor

The down conductor should be used 25 x 3 mm copper strip. Two down conductors shall be used in case of the structure height is above 28mts and both should be connected with maintenance-free Grounding system.

The main copper conductor shall be connected directly to the air termination. The down conductor shall be installed in accordance with the manufacturer's instructions and should not be subject to sharper bends. The down conductor must be kept in constant physical contact with the structure via conductive mounting clamps.

5. Lightning Flash Counter

Each protection system shall be supplied with Lightning strike counter. The counter shall have a register that activates one count for every discharge where the peak current exceeds 400A at the 8/20us standard.

The lightning flash counter shall be robust and easy to install. The counter shall operate from the energy of the lightning discharge and should not work on external or battery power to operate.

The lightning flash counter shall be installed to the manufacturer's instructions in a readily accessible manner (always 2mts above the Ground) so that reading can be taken at regular intervals. It shall be positioned such that its operating temperature is within the range -20'C to + 60'C.

6. Grounding System

(i) Maintenance free Earthing Electrode System/ Chemical Earthing

In maintenance free earthing copper bonded earthing rod electrode shall be of 14.35 mm in diameter and 3 meter length. The rod shall be placed in a 150 mm dia an augured hole in the ground and then surrounded by ground enhancement material in either a dry form or pre mixed in a slurry. Once set, ground enhancement material becomes hard and as such holds positively to the rod as well as surrounding ground.

Earth rod offered shall have passed the test required of BS7430/ ANSI/ UL467 and confirm to the adhesion of the copper coating to the steel core (Design feature that prevents the ingress of moister and subsequently the integrity of the rod.

Minimum 0.25 mm thickness of copper shall be deposited over the steel core as per BS 7430/ UL 467. Average life of the ground rod shall be 30 years in most soil.

Ground enhancement material shall be as per IEEE-80 clause 14.5d with a resistivity of less than 0.12 ohm-meter. The ground enhancement material shall be permanent and not leach any chemicals in to the ground. The pH value of the ground enhancement material shall be 6.9 to 7.2 of 100 gm/ lit @ 20 deg.C.

Minimum 30 Kg of ground enhancement material shall provided for each earth electrode.

Inspection chamber shall be of 400 x 500 mm with concrete base CI manhole cover with frame painted with bitumastic paint. 2 Nos. of 50 x 6 mm cross section & 300 mm long copper strip to be clamped with copper claded rod electrode have sufficient nos (But not less than 4 Nos.) of 10□ mm GI nuts & bolts for connection to the equipment /

interconnection to the other pits to form equi-potential bonding.

SECTION – XIV : INSTALLATION OF ELEVATORS

1. Scope of Work

The work to be done under this section comprises the supply & installation necessary for the complete installation of the elevators as per latest NBC norms.

The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The indicative specifications are as below :

Sl. No.	Technical Parameter	Technical data required as per Tender
1	Lift Capacity	13 Passenger (or) as per relevant IS & NBC norms.
2	Lift Type	Service Lift with Gearless Motor and with / without Machine Room. (Vendor, if required can make use of the machine room of the existing lift).
3	Make	OTIS / KONE / SCHINDLER / JHONSON / ZION
4	Participants	Only OEMs are allowed to participate.
5	Warranty	1 Year
6	Speed	1.0 m/s (or) as per relevant NBC / IS Norms.
7	Type of Drive	Microprocessor based VVVF Drive (V3F)
8	No. of stops & openings	As per building requirements.
8	No. of entrance	Single entrance at same side.
9	Car size	As per relevant norms.
10	Power supply	415V-3 phase, 50 cycles AC
11	Auxiliary power	Single phase, 220V, 50 cycles AC.
12	Car Enclosure	Stainless steel hair line finish.
13	Car entrance	Center operated power doors with half glass (fire rated) stainless steel hair line finish.
14	Landing entrance	
15	Flooring	Granite flooring
16	Indicators	Lift Arrival alert & indicator at all landings & Floor announcer Inside the Car.
17	Controls	Microprocessor based simplex full collective control with or without attendant operation.
18	Other features included	1. Entrance vertical and sill supports at all landings.
		2. Call register indicator.
		3. Micro movement back lit push button for car and landings.
		4. Emergency Alarm.
		5. Balustrade or suitable safety for service personal on cabin top,

	as per the standards.
	6. Emergency light.
	7. Emergency Rescue Device (ERD).
	8. Automatic rescue Device (ARD).
	9. Fire rescue Device (FRD).
	10. Load weighting device (LWD).
	11. Pit ladder.
	12. Built in voltage stabilizer for control gear Auto/attendant key.
	13. Press and speak phone / 3 way intercom.
	14. Floor annunciator with music.
	15. Infrared full door screen.
	16. Braille button.
	17. Suitable fan on ceiling.
	18. SS Handrail inside the car.
	19. Non-Stop button for VIP Passengers.
	20. Fireman Switch.
	21. Mirror on the wall opposite to the door.
	22. Display instruction board (SS).
	23. Call Cancel button / provision (Optional).

2. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the Elevators for the defects liability period. Further, he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of ONE years beyond the defects liability period.

SECTION – XV : ON GRID ROOFTOP SOLAR POWER PLANT

1. Scope of Work

The work to be done under this section comprises the supply & installation necessary for the complete installation of the Solar Power Plant.

The design of the components shall be traceable to field research, laboratory testing, fundamental analysis, and statistical levels of the lightning event.

The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

The plant should be as per MNRE Norms.

2. OPERATION AND MAINTENANCE

Contractor may be required to carry out the operation of the Solar Power Plant for the defects liability period. Further, he may also be required to carry out operation and all-inclusive maintenance of the entire system for a period of FIVE years beyond the defects liability period.

SECTION – XVI : FAÇADE ILLUMINATION / LIGHTING WORKS

1. Scope of Work

The work to be done under this section comprises the supply & installation necessary for the complete installation of the Facade Lighting works as per the final building design.

The design of the components shall be traceable to long term practical field studies laboratory testing, fundamental scientific principles and statistical levels of the lightning event as documented in international standard.

ANNEXURE-I

REGULATIONS AND STANDARDS

All equipment's their installation, testing and commissioning shall confirm latest CPWD/ IS specifications in all respects. Indian Standard Code of Practice for Electrical Wiring Installation IS:732-1989. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code, National Building Code 2016, ECBC, latest CPWD specifications amended up to date and requirements of the Local Electric Supply Authority. In general, all materials equipment and workmanship shall confirm to the Indian Standards specifications and codes latest as amended. Some of the applicable codes/standards are as under:

RELEVANT STANDARDS		
1	Ceiling fans and regulators (3rd revision)	IS : 374 - 1979
2	PVC insulated Electric cable for working voltage upto and including 1100 volts.	IS : 694 - 1990
3	Code of practice for electrical wiring and installation	IS : 732 - 1989
4	Code of Practice for installation and maintenance of Power Cables upto and including 33 KV rating (Second Revision)	IS : 1255 - 1983
5	Bayonet lamp holders(Third revision)	IS : 1258 - 1987
6	Three pin plugs and sockets outlets rated voltage upto and including 250 volts and rated current upto and including 160 amps.	IS : 1293 - 1988
7	PVC insulated (Heavy Duty) electric cables for working voltages upto and including 1100 volts.	IS : 1554 - 1988 (Part - I)
8	Electrical installation fire safety of buildings (general) Code of practice.	IS : 1646 - 1982
9	Glossary of items for electrical cables and conductors	IS : 1885 - 1971
10	General and safety requirements for fluorescent lamps luminaries Tubular.	IS : 1913 - 1978
11	Power Transformers	IS : 2026 - 1977 to 81 (Part I to IV)
12	Methods of high voltage testing	IS : 2071 - 1974 - 76
13	Protection of building and allied structures against lightning	IS : 2309 - 1989
14	Danger notice plate.	IS : 2551-1982
15	Code of practice for earthing.	IS : 3043 - 1987
16	AC Metal enclosed switch gear and control gear for rated voltages above 1 KV and upto and including 52 KV.	IS : 3427 – 1997
17	Flexible steel conduits for electrical wiring.	IS : 3480 - 1966
18	Accessories for rigid steel conduit for electrical wiring.	IS : 3837 - 1976
19	Application guide for voltage transformers	IS : 4146 - 1983
20	Switch socket outlets.	IS : 4615 - 1968
21	Boxes for the enclosure of electrical accessories.	IS : 5133 - 1969 (Part -I)

22	Guide for safety procedures and practices in electrical work.	IS : 5216 - 1982 (Part-I)
23	Rubber mats for electrical purposes.	IS : 5424 - 1969
24	Marking and arrangement of bus bars	IS : 5578 & 11353-1985
25	Cross linked polyethylene insulated PVC sheathed cables. For working voltages from 3.3 KV upto and including 11 kV	IS : 7098 - 2011 (Part - II)
26	Conductors for insulated electric cables and flexible cords	IS : 8130 - 1984
27	Factory built assemblies of switchgear and control gear for voltages upto and including 1000 V AC and 1200 V.D C.	IS : 8623 -1977 (Part -I)
28	Bus Bar trunking system	IS : 8623 - 1980 (Part -II)
29	Miniature Circuit Breakers	IS : 8828 - 1996
30	Rigid Steel Conduits for electrical wiring (Second Revisions)	IS : 9537 - 1981
31	Methods of test for cables.	IS : 10810 - 1988
32	Earth Leakage Circuit Breakers	IS : 12640 - 1988
33	Air Circuit Breakers	IS : 13947-1993 (Part-II)
34	Moulded Case Circuit Breakers	IS : 13947-1989
35		(Part-)
36	Degree of protection provided by enclosures for LV switchgear and control gear.	IS : 13947 - 1993 (Part-)
37	General requirement for switchgear and control gear for voltage not exceeding 1000 Volts.	IS : 13947 - 1993 (Part-)
38	Stationary cells and batteries lead acid type.	IS : 1651 & 1652 1991
39	CPWD General specifications for electrical works	Part-I (Internal) 2023
40	CPWD General specifications for electrical works	Part-II (External) 2023
41	CPWD General specifications for electrical works	Part-III (Lifts & Escalators) 2003 & Bill No 22-HLA of 2020/68/11517b dt 24.08.2020 – The Haryana Lifts and Escalators (Amendment) Bill 2020.
42	CPWD General specifications for electrical works	Part-IV (Substation) 2013
43	CPWD General Specifications for Electrical Works	Part V, Wet Riser & Sprinkler System - 2020

44	CPWD General Specifications for Electrical Works	Part VI, Fire detection and Alarm System-2018
45	CPWD General specifications for electrical works	Part VII, (DG Sets) 2013
46	CPWD General specifications for electrical works	Part VIII, Gas Based Fire Extinguishing System - 2013
47	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353 -1985
48	Low voltage switchgear and control gear assemblies	IS/IEC 61439
49	Specification for low voltage switchgear and control gear assemblies	IS 8623 (Part -2-1993)
50	Code of practice for selection, Installation and maintenance of switchgear and control gear.	IS 10118 Part – 1 - 4
51	PVC insulated (heavy duty) electric cables	IS 1554
52	PVC insulated cables for working voltages up to and including 1100V.	IS 694
53	Conduit for electrical installations	IS 9537
54	Accessories for rigid steel conduits for electrical wiring	IS 3837
55	Boxes for the enclosure of electrical accessories	IS 14772
56	General and safety requirements for luminaries	IS 1913
57	Code of practice for earthing	IS 3043
58	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
59	Low Voltage switchgear and control gear	IS 13947 Part 1 – 5
60	Residual current operated Circuit Beakers	IS 12640
61	Current Transformers	IS 2705
62	Voltage Transformers	IS 3156
63	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
64	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200 V DC.	IS 13947 & IS 1336
65	High-voltage switchgear and control gear - Common specifications	IEC: 62271 - 1
66	Measuring relays and protection equipment - Part 24: Common format for transient data exchange (COMTRADE) for power systems.	IEC: 60255
67	Current Transformers	IEC: 600441-1
68	Voltage Transformers	IEC: 600441-2
69	Standard Voltages	IEC: 60038
70	Switch gear assemblies including metal enclosed bus.	ANSI IEEE C 37/20

In case of contradiction in specification the priority of the documents shall be CPWD / IS Specifications / NBC Norms, Drawings, Technical Specifications.

ANNEXURE - II

**Tenderer must fill in the Required following Technical Data
Technical Data for switchgear cubicle type with VCB Breaker**

VCB BREAKER**Switchgear Cubicle**

- i. Make
- ii. Type
- iii. Reference Standard
- iv. Voltage (System/Rated)
- v. Phase/Frequency
- vi. Short Circuit Rating
 - a. Interrupting Symmetrical
 - b. Short time for 1/3 sec.

Construction

- i. Drawout feature for Circuit Breaker with Service Test & Disconnected
- ii. Minimum clear space required at:
 - a. Front for breaker withdrawal
 - b. Rear
- i. Overall dimension & Operating weight

Bus Bar

- i. Material & grade
- ii. Reference standard
- iii. Cross sectional area size
- iv. Continuous current at 40 deg C
- v. Max temp rise over for 40 deg C
- vi. Short time current for 1/3 sec.

VCB BREAKER

- vii. Min clearance of bare bus bar & connection
 - a. Phase to phase
 - b. Phase to ground

Circuit Breaker

- i. Make
- ii. Type
- iii. Rated voltage
- iv. Rated frequency
- v. No. of poles
- vi. Rated current
 - a. Continuous at 40 deg C & within cubicle
 - b. Short time current for 1 sec/3 sec

Max. temp rise over 40 deg C ambient

Rated operating duty

Interrupting capacity at rated voltage and operating duty

- a. Symmetrical

Rated making current

No. of breaker operations permissible without requiring inspection for refilling SF6 gas replacement of contacts & other main parts.

Not Applicable

- a. At 100% rated current
- b. At 100% rated short circuit current

Type of contacts

- a. Main
- b. Arcing

Min clearance in air

- a. Between poles
- b. Between live parts & ground

VCB BREAKER

Operating mechanism

- a. Type
- b. No. of breaker operations stored
- c. Trip free or fixed trip?
- d. Antipumping features provided

Closing Coil

- a. Voltage
- b. Permissible voltage variation
- c. Power required at rated voltage

Breaker/breaker cubicle provided with the following :

- a. Mech. safety interlocks
- b. Automatic safety shutter
- c. Emergency manual trip
- d. Mech. ON/OFF indicator
- e. Operation counter
- f. Spring charge/discharge indications
- g. Manual spring charging facility
- h. Mechanical Antipumping

Net weight of the breaker

Impact load for foundation design

Overall dimensions in mm

DC voltage required for trip ckt and
Annunciation / indication ckt.

TRANSFORMER

S. No. Technical Parameters	Oil Filled TYPE
1. Type and class of insulation	
2. Output in KVA (Continuously rated)	
3. Rated Voltage	
a. HV (Volts)	
b. LV (Volts)	
4. No. of phase	
5. Type of cooling	
6. Frequency	
7. Winding Connection	
8. Tapings	
9. Vector Group	
10. Ref. Ambient temperature	
Temperature rise winding	
Class of insulation	
11. Physical Dimensions	
a. Length (in mm)	
b. Width (in mm)	
c. Height (in mm)	
12. % Impedance	
13. Iron losses at normal voltage ratio	
14. Copper loses at normal voltage ratio at full load	
15. Efficiency at unity power factor	
a. Full load	
b. 75% load	
c. 50% load	

S. No. Technical Parameters

**Oil Filled
TYPE**

16. Regulation at unit power factor
17. Regulation at 0.8 power factor
18. Approximate weight
 - a. Core & winding (Kgs.)
 - b. Total Weight (Kgs.)
19. Oil (Ltrs)

L.T LOAD BREAK SWITCH

Item	Data to be furnished by tenderer against each item
COMPONENTS	
Air Circuit Breakers	
Make	
Ics value	
DC voltage for shunt trip coil	
MCCBs	
Make	
Ics	
Balance component makes	
MV Contactors	
Capacitors	
Energy Management System	
Energy Meter	
Cast Resin current transformers	
Meters	
Selector switches	
Protective relays	
APFC relay	
CONSTRUCTIONAL FEATURES	
Material – CRCA or Hot Rolled MS sheets	
Sheet metal thickness for Panels and doors	
Ingress protection.	
Base channel details	
Blank space between floor of switchboard and bottom most units.	

Overall Height	
Provision for 25% spare feeders	
Bus bar size	
Bus bar insulation	
Bus bar jointing	
Whether accessible bare joints shrouded ?	
Whether knockouts for cable/conduit entry provided ?	
Whether cable termination kits, lugs, glands etc provided ?	
Details of surface treatment prior to Painting	
Paint finish provided ?	

ANNEXURE - III
LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS

SL. No	Details of Material& Equipment Name	Manufacturer's Name
HIGH VOLTAGE EQUIPMENT		
1	Compact RMU: 33 & 11 kV	EATON, LUCY, SCHNEIDER ELECTRIC, ABB, L&K, CG
2	VCB : 33 & 11 kV	SCHNEIDER ELECTRIC, SIEMENS C&S, ABB, L&K, CG
3	33/11 kV & 11 / 433 V Oil cooled transformer	KIRLOSKAR, ABB (HITACHI), SCHNEIDER ELECTRIC, ESSENAR, HITACHI, CG
4	HT Jointing Kit : 33& 11 kV	Birla-3M, IKEBANA, M-Seal, Raychem
5	HT Termination Kit : 33 & 11 kV	Birla-3M, IKEBANA, M-Seal, Raychem
6	XLPE Cable : 33& 11 KV	POLYCAB, HAVELLS, RALLISON, APAR
7	Protection Relays Numeric Type	ABB, Schneider Electric, Siemens
8	Potential Transformer	ECS, Jyoti, Kappa, Pragati, TECHHANS
9	Current Transformer (Cast Resin Epoxy Coated)	ECS, Jyoti, Kappa, Pragati, TECHHANS
10	Static Power Meter & Logger (Trivector Meters)	ABB, El Measure, Larsen & Toubro, Schneider Electric, Secure
11	Electronic Digital Meter (A/V/PF/HZ/KWH) with LED Display.	ABB, Automatic Electric, Larsen & Toubro, Schneider Electric, NEPTUNE
12	HRC Fuse and Fuse Fitting	GE, Siemens
13	Battery Charger	Caldyne, Chabbi Electricals, Star Cap. Engg., Volstat
14	Sealed Maintenance Free Batteries	Exide, Global, Hitachi, Shinkobe

B.	MEDIUM VOLTAGE EQUIPMENT	
1.	A) Power Distribution Panel B) Feeder Pillar	SHIVALIC POWER ADLEC LS POWER, TRICOLITE NEPTUNE SHIVALIC POWER ADLEC LS POWER, TRICOLITE NEPTUNE
2.	Air Circuit Breaker (3/4 Pole)	LEGRAND ABB Schneider Electric Siemens
3.	Moulded Case Circuit Breaker (MCCB)	LEGRAND ABB Schneider Electric Siemens
4.	Motor Protection Circuit Breaker(MPCB)	LEGRAND ABB Schneider Electric Siemens
5.	Miniature Circuit Breakers (MCB)	LEGRAND ABB Schneider Electric Siemens
6.	Overload relays with built in Single Phase preventer	ABB GE Power Controls Larsen & Toubro Mitsubishi Electrical Schneider Electric Siemens
7.	Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display	ABB NEPTUNE Schneider Electric
8.	Static Power Meter & Logger (SPML) With RS 485 port	Conzerv Larsen & Toubro Schneider Electric
9.	Power Capacitor	ABB Neptune Ducati Schneider Electric
10.	PVC insulated XLPE aluminium/copper conductor armoured MV Cables upto 1100 V grade	Polycab APAR RALLISON, RR V-MARC
11.	LT Jointing Kit / Termination	Baliga Lighting Comet Cosmos
12.	Cable Glands Double Compression with earthing links	Baliga Lighting Comet Cosmos
13.	Bimettalic Cable Lug	Comet Cosmos Dowell's (Biller India)

		Hax Brass (Copper Alloy India)
14.	Power/Aux. Contactor	ABB Larsen & Toubro Schneider Electric Siemens
15.	Change Over Switch	Control & Switchgear Havells H H Elcon HPL – Socomec Larsen & Toubro
16.	Automatic Transfer Switch (ATS)	ASCO GE Power Control Cummins SOCOMEK
17.	Control Transformer/Potential Transformers	Automatic Electric Gilbert & Maxwell Indcoil Pragati TECHHANS
18.	Current Transformer (Epoxy Cast Resin)	Automatic Electric Gilbert & Maxwell Indcoil Pragati TECHHANS
19.	Protection Relay (Numeric Type)	ABB Areva Larsen & Toubro Prok Devices Pvt. Ltd Siemens
20.	Indicating Lamps LED type and Push Button	GE Power Controls Larsen & Toubro (ESBEE) Schneider Electric Siemens Vaishno Electricals
21.	Electronic Digital Meters (A/V/PF/Hz/KW/KWH) with LED Display	NEPTUNE L & T Schneider Electric Socomac

Note : Preference will be given to use maximum number of available products/ accessories from the selected manufacturer for projects AS Approved by BANK ENGINEER/CONSULTANT.

DIESEL GENERATORS

SPECIAL CONDITIONS

1. SCOPE OF WORK

- 1.1 The scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Project Manager. The contractor shall furnish all labour, materials and equipments as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete power generating system through Diesel Generator as described in the Specification and as shown on the drawings. This also includes any material, equipment, appliance and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

The scope of work is as follows but not limited to:

- a. Radiator cooled Diesel Generator complete with base plate, anti-vibration isolators and all fixing accessories as required.
- b. Residential type silencer, complete with hot dip galvanized supports & brackets, hardware etc.
- c. Starting battery in non-returnable containers complete with stand and other accessories.
- d. Exhaust piping, duly insulated with mineral wool and aluminium sheet cladding.
- e. Hoisting and handling facilities such as cranes, tools and tackles specially required for this kind of equipments and for lowering equipments where ever it is to be installed either within building or outdoor at platform.
- f. DG synchronization Panel
- g. DG flue pipe structure.

2. CIVIL WORKS RELATED TO ELECTRICAL INSTALLATION

- 2.1 Following civil works associated with Power Generating (PG) set installation are excluded from the scope of this tender. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the generator contractor.
- a. RCC Foundation with angle iron frame work at the edges as per manufacturer's requirement and rating of generator sets.
 - b. Cutout in walls and floors, opening for cable / bus ducts exhaust pipes etc. If any opening is to be made after the floor / slab / wall is built, it shall be the responsibility of the generator contractor to make such openings and make them good after the installation and no extra payment shall be made for such extra works.
 - c. Trenches for laying of cables.

3. AWARENESS OF SITE CONDITIONS AND SITE INSPECTION PRIOR TO TENDER SUBMISSION

Prior to the preparation and submission of tender, the contractor shall make visits to the site and carry out all the necessary inspections and investigations in order to obtain all information's and to make his own assessment of the conditions and constraints at site including the means of access to generator area. The contractor shall make himself aware of all the features of the site, working conditions and shall be responsible for obtaining all the necessary required information needed for him to prepare and submit his tender.

4. CO-ORDINATION WITH OTHER CONTRACTORS AND AGENCIES

- 4.1 The contractor during the execution of the works shall co-ordinate with other agencies associated with the project and shall work in harmony with them without causing any hindrance or obstruction on the progress of work in any way.

Other contractors and agencies that the contractor shall be required to coordinate with are:

4.1.1 Internal / External Electrical Services Contractor

Contractors shall co-ordinate with Electrical services contractor regarding.

Laying of cables on cable trays.

Lighting in the generator area

Interfacing with any works carried out by other electrical services contractor.

4.1.2 Civil Works Contractor

To coordinate with civil works contractor to provide foundation, sleeves, insert plates, supports, openings etc., necessary for the power generating sets installation work in compliance with the construction programme.

4.1.3 HVAC System Contractor

To coordinate cable tray layout with respect to ducting, piping and ventilation system layout in case of indoor installation.

4.1.4 Plumbing & Water Supply Contractor

To collect and coordinate all the relevant information regarding water supply and drainage pipes.

4.1.5 Fire Protection System Contractor

To collect and coordinate all the relevant information regarding the fire protection system in the Power Generating area.

5. SHOP DRAWINGS

- 5.1 All shop drawing shall be prepared on computer through Autocad system based on Architectural drawings and site measurement within two weeks of award of work. Contractor shall furnish for the approval of the Project Manager, four sets of detailed shop drawings of all equipment and material giving following information.

- a. Certified foundation details
- b. Layout of generators and associated equipment,
- c. Day oil tanks
- d. Piping layout diagram.
- e. Exhaust pipe routing, damper positions.

5.2 Within two weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation statement in quantity, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

6. COMPLETION DRAWINGS

6.1 Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of four sets of CD's and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate following:

- a. Location and rating of generator.
- b. Complete wiring diagram, as installed and scheduled showing all connections in the complete electrical system in the generator room.
- c. Single line diagram, power schematic, control schematic with detailed bill of materials, showing makes, types and description of all components and accessories.

7. OPERATING INSTRUCTION & MAINTENANCE MANUAL

7.1 Upon completion and commissioning of Power Generating system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner's site representative and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment. These manuals shall include:

- a. Description of the work carried out / installed.
- 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.

8. PERFORMANCE TESTING

8.1 DG sets shall be tested at varying loads at manufacturers works/site prior to dispatch of the sets to site. The performance tests at the works shall be carried out in presence of authorized representative from the Clients. Due notice for the programme of performance testing at works shall be given to the Clients to enable them to arrange

for their representatives for this inspection to be at manufacturers works/site for this inspection and testing.

- 8.2 The performance test on each DG sets shall be of minimum 8 hours duration. It should also include measurement of noise and emission as per standards and latest CPCB guidelines. Vibration measurement shall also be done as per engine manufacturer's recommendation and ISO – 8528 Part - 9.
- 8.3 All instruments, materials, consumables (fuel oil, lube oil etc.) load and labour required for carrying out of the test shall be provided by the Contractor.

Following test acceptance criteria shall be applicable.

a.	Fuel consumption at 50%, 75%, 100% and 110% load.	± 5% of guaranteed performance. Actual alternator efficiencies as determined in the manufacturer's works tests shall be used as the basis of calculation of specific fuel consumption ratio.
b.	Voltage regulation from no load to full load	± 1%
c.	Frequency regulation from no load to full load	± 0.5%
d.	Maximum water temperature	± 5% of guaranteed performance
e.	Maximum lube oil temperature	± 5% of guaranteed performance
f.	Minimum lube oil pressure	± 5% of guaranteed performance
g.	Lub Oil consumption	± 5% of guaranteed performance

- 8.4 Upon completion of work the performance test shall demonstrate the following among other things:
- i. Equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.
 - ii. All items operate efficiently and quietly to meet the specified requirements.
 - iii. All circuits are correctly protected and protective devices are properly coordinated.
 - iv. All non current carrying metal parts are properly and safely grounded in accordance with the specifications and appropriate codes of practice.

9. PRE-COMMISSIONING CHECKS

- 9.1 All standards checks including the ones elaborated in the specifications to ensure that the installation of the DG sets and associated systems has been carried out satisfactorily shall be done on completion of installation. These shall include.
- 9.2 DG sets
- Checking of piping interconnections
 - Checking electrical interconnections
 - Checking of insulation resistance
 - Checking of earthing
 - Checking of instruments and controls.

- Checking of alignment
- Checking of vibration transmission to building structure.
- Checking of expansion joints.

9.3 Exhaust system

- i) Checking of silencer operation
- ii) Checking of surface temperature of exhaust piping

9.4 Fuel system

- i) Checking of piping interconnections and pumps.

10. TYPE TEST

Copies of manufacturer's type test for the engine and the alternator of all ratings shall be enclosed along with the dispatch of the DG sets.

11. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved makes.

12. COMPLETION CERTIFICATE

On completion of the Generator installation, a certificate shall be furnished by the contractor countersigned by the licensed electrical supervisor under whose direct supervision of the installation was carried out. This certificate shall be in the prescribed form as required by the local supply authority.

13. TRAINING OF OWNER'S PERSONNEL FOR OPERATION AND MAINTENANCE

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

14. COMPLETION TIME & TIME DELAY PENALTY

14.1 Completion Time

The entire work shall be completed within the time frames stipulated during negotiations. If the completion of work is delayed beyond the period due to reasons considered by Owners to be **beyond** the control of Contractor, extension of time for the completion of the work shall be granted by the Owners without the levy of the time delay penalty. The extension of time shall however not entitle the Contractor to claim any extra payment and/or compensation on this account.

14.2 Time delay penalty

If the completion of the work is delayed **beyond 1** month from the date of award of work (or duly extended time period), due to reasons considered by Owners **to be within** the control of Contractor's Owners reserve the right to impose Time Delay Penalty on the Contractor @ 0.5% of the total contract value per week of delay subject to a maximum of 10% of the total contract value.

15. PERFORMANCE GUARANTEE

The entire work executed under this contract shall be guaranteed against manufacturing defects and/or bad workmanship for a period of one year after the date of contractual completion as defined in para 14.1 above. Any defect arising out of reasons attributable to manufacturing defect and/or bad workmanship, in the assessment of Owners, shall be rectified/replaced to the satisfaction of the Owners free of cost to the Owners during this Performance Guarantee period. 10% of the contract amount shall be retained by the Owners as security deposit during the defects liability period of one year after completion and successful handing over.

16. TERMS OF PAYMENT

16.1 Following terms of payment shall apply:

10% of contract value as mobilizing advance against bank guarantee on award of work

60% of contract value on delivery of equipment at site.

20% of contract value on completion of installation, testing and commissioning and after submission of statutory approvals (permission from supply company authority, clearance from electrical inspector and clearance from pollution control authority) and submission of operating manuals etc.

10% of contract value shall be retained and released after DCP.

17. ENGINEER AND FOREMAN

The contractor shall employ a competent, fully licensed, qualified full time electrical / mechanical engineer and foreman to direct the work of installation in accordance with drawings and specifications. The foreman shall be available at all times at site to receive instructions from the Project Manager / Consultant for day to day activities throughout the duration of the contract. The foreman shall correlate the progress of the work in conjunction with all relevant requirements of the supply authorities.

18. DEMONSTRATION TO OWNER

18.1 Upon completion, devices subject to manual operation shall be operated atleast five times in presence of Project Manager/Consultants to demonstrate satisfactory operation.

18.2 The contractor shall provide performance tests upon completion of the installation. He shall arrange all necessary instruments, tools and tackles to check sound level, vibration and the effectiveness of acoustical treatment and vibration isolator installed.

19. TOOLS AND TACKLES

The Contractor shall provide and install all necessary hoists, ladders, scaffolding, tools, tackles, transportation of labour and materials necessary for the proper execution and completion of the work to the satisfaction of the Project Manager / Consultants.

20. OPERATION AND MAINTENANCE

20.1 Contractor may be required to carry out the operation of the Power Generating set for the defects liability period. Further, he may also be required to carry out operation and ive maintenance of the entire system for a period of three years beyond the defects liability period.

20.2 Operation contract

- i. 24 hours a day, year round.
- ii. All stand-by equipment to be operated as per mutually agreed programme.
- iii. Proper entry and upkeep of relevant log books.
- iv. Maintain complaints register. Submit weekly report.
- v. Proper housekeeping of all areas under the contract.
- vi. Prepare daily consumption report and summary of operation.

20.3 Terms of payment

- i. Monthly at the end of each month on pro-rata basis.

21. APPROVAL & CLEARANCE

21.1 All associated activities stated as under or required for necessary clearances / permissions / approvals / licenses from concerned authorities in order to install DG set and run DG set, are in the scope of DG supplier.

- a. Approval from Airport authority of India for the clearance of chimney height.
- b. Approval from Pollution control board authority.
- c. Approval from local town development authority.
- d. Approval from local Police.
- e. Approval from controller of explosives.
- f. Approval from food and supplies department for fuel.

21.2 Only receipted amounts shall be reimbursed by the client on production of proof of payment. All necessary documents required shall be provided by Owner.

DIESEL GENERATOR SETS TECHNICAL SPECIFICATIONS

1. GENERAL

Work covered by this contract shall include design, manufacture, supply, transportation, delivery, installation, testing and commissioning of Radiator Cooled Silent Diesel Generator Set including Acoustic Enclosure suitable for outdoor installation and exhaust piping as required. **Technical particulars enclosed as Annexure-I, I.1, I.2 of this specifications shall be filled in by the tenderer and enclosed along with the tender.** Tenderers may submit alternative offers of imported equipment also.

2. STANDARDS

- 2.1 The equipment offered shall conform to the latest revision of relevant Indian or British Standard (BSS.) and Codes together with the requirements of the Local Supply Authority.
- 2.2 Tenderers shall clearly state the standards to which the equipment they are offering conform.

3. ENGINE AND ACCESSORIES

3.1 General

The DG sets shall be complete with all components, fittings, accessories, instruments, visual and audible alarms, indications, controls and protection required for fully reliable and safe operation of the DG sets whether specifically stated in these specifications or not.

3.2 Engine

The engine shall have the following characteristics:

Type	-	Suitable for generating set application, turbo charged, multi-cylinder, solid injection, cold starting.
Cycle	-	Four stroke.
Speed	-	1,500 r.p.m.
Speed Variation	-	Within 2% for operation between 10% and 100%
Method of Starting	-	Battery
Net site output	-	This shall be rating under the ambient conditions prevailing at site for standby duty. De-rated ratings for continuous duty shall be furnished.

3.3 Starting

- 3.3.1 Starting system of the standby generator shall be of a heavy-duty electric motor complete with a 24 V.D.C. heavy-duty battery of required AH. The electric motor shall be capable of cranking the engine to achieve the rated speed in less than 10 seconds from the initiation of the starting process. The electric start battery shall be of adequate capacity for 6 successive starts. Time delay relays shall be incorporated to provide a rest period of 1-5 seconds (adjustable) before each successive start and a time lag period of 19-100 seconds (adjustable) before the system lock out due to failure of the 5th start to crank up the engine.
- 3.3.2 The generator set shall be provided with a micro-processor based control system which is manufactured to provide automatic starting, monitoring, and control functions for the

generator set. Interface to BMS system according to point schedule on drawings shall be provided.

- 3.3.3 The control system shall include an engine governor control, which shall function to provide steady state frequency regulation. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

3.4 Fuel Consumption

- 3.4.1 The engine shall be suitable for satisfactory operation on H.S.D. as locally available. The tenderers shall declare the guaranteed fuel consumption in liters per BHP/hr, in accordance with standard practice at 50%, 75% and 100% load under the maximum output after de-rating to ambient conditions.
- 3.4.2 Such guaranteed fuel consumption is also to be expressed in liters per gross / net kWh output from the alternator (after supplying the requirements of auxiliaries) at 50%, 75% and 100% load and at 0.8 and unity power factors.
- 3.4.3 If guaranteed fuel consumption is exceeded, the Contractor shall make such amendments or alterations as are necessary to bring the consumption to within the guaranteed figures.
- 3.4.4 Tolerance of + 5% as defined in BSS-649-1958 shall be allowed.

3.5 Lubricating Oil Consumption

The tenderers shall state the guaranteed lubricating oil consumption in liters per hour.

3.6 Governing

The governor shall be of mechanical type with governing class A direct.

3.7 DG Set Mounting

The engine and direct coupled alternator shall be rigidly secured to a common truly rigid base frame fabricated from MS sections and shall be provided with anti-vibration mountings so as to permit a maximum of 5% vibrations to be transmitted.

3.8 Exhaust System

- 3.8.1 The engines shall be fitted with a Residential type Silencers of design approved by the engine manufacturer.
- 3.8.2 Silencer outlets shall be connected to exhaust piping carried to the top of the building through shafts provided for the purpose. Exhaust piping shall be fabricated from class 'B' MS pipes of size suitable to limit back pressure to within permissible limit (2.5" of Hg.). Tenderer shall submit design calculation in support of the back pressure being within limits along with the tender. It is important to ensure that the surface temperature of the exhaust piping remains in permissible limit. For this purpose, the entire length of exhaust piping shall be insulated with minimum 75 mm thick layer of rock wool mattress/blanket of 150kg/mt³ density preferably with factory applied wire netting of G.I. The insulation shall be covered with 22 SWG aluminium sheet cladding. Flanged joints in the exhaust piping shall be covered with removable insulation at suitable intervals for permitting access to the joint

when required. Exhaust piping shall be connected to the engine by means of flexible section or an expansion joint.

3.9 Air Filters

The engine air intake shall be fitted with a substantial air cleaner of paper element type.

3.10 Crank Case Breather

The crankcase breather outlet of the engine shall be fitted with a filter cap capable of preventing entry of dust.

3.11 Fuel and Lubricating Oil Filters

Filter for fuel and lubricating oil systems shall be of simplex type. Lubricating oil filters shall be of an efficient full flow type of ample capacity and suitable for use with detergent oils. They shall be capable of removing all foreign matter above a particle size of 5 microns.

3.12 Lubricating Oil System

The engine shall be of the totally enclosed type and fitted with a positive pressure system of lubrication to all working parts. Lubricating oil shall be circulated in the engine by an engine driven pump. There shall be no moving part requiring lubrication by hand prior to the starting of the engine or while in operation.

3.13 Safety Controls

3.13.1 Low Lubricating Oil Pressure

Pressure sensors shall be fitted such that in the event of a fall in the lube oil pressure, an alarm and indication shall be actuated. In addition, the engine shall be automatically shut down in the event of lube oil pressure dropping to a predetermined low value.

3.13.2 High Water Temperature

An alarm shall be given if the water temperature exceeds the safe limits and the engine shall be shut down when a pre-determined set water temperature is reached.

3.13.3 High Enclosure Temperature

An alarm shall be given if the water temperature exceeds the safe limits and the engine shall be shut down when a pre-determined set enclosure temperature is reached.

3.13.4 Over Speed

Speed control shall be so arranged that a 12-1/2% increase over normal rated speed shall cut off fuel supply, thus stopping the engine.

3.13.5 Overload Protection

The engine shall be adequately protected against operating under overload conditions. The requirements shall be met by the provision of a fixed overload limit stop on the fuel pump rack control rod to prevent the set being subject to a load exceeding the site rating plus 10%.

3.13.6 Excess Starting Time

The starting circuit for the automatic mains failure diesel generator sets shall be arranged to attempt upto three starting cycles, each not exceeding 10 seconds duration with a similar OFF period between each cycle. If the set fails to start upon completion of the third attempt the starting circuit shall be locked out until it is restored manually. An alarm shall be given and "Set failed to start" indication given on the panel.

Provision shall also be made to avoid re-engagement of the starter pinion until after the engine has come to rest. Failure of the starter motor to disengage shall close down or lock out the engine.

3.13.7 Fuel Level Protection

A level sensor shall be provided in the day fuel tanks to give visual and audible alarms if the level in the tank falls to below 1/4 full.

3.13.8 Interlocking with electrical controls

Whenever the engine is shut down due to over speed, low lubricating oil pressure, high water temperature or excess starting time, the circuit breaker shall also be tripped and the starting systems of the engine shall be locked out until the respective protective relay is reset.

3.14 Instruments and Accessories for Engine

3.14.1 Instruments and accessories to be provided with the engine shall be (but not limited to) as below:

a) **Accessories:**

Flywheel with starter ring.
 Flexible coupling with guard.
 Air cleaner paper element type.
 Corrosion resistor.
 Vacuum indicator
 Radiator .
 Governor –electronic.
 Fuel filter & Lube. oil filter.
 Fuel pump with pre and micro fuel filters
 Water pump
 Lube oil pump
 Electric starting system including heavy duty batteries with leads and battery charger.
 Exhaust silencer residential type
 Interconnection wiring, cabling and piping as required
 Set of standard tools
 Engine test certificates
 Engine maintenance manual

b) **Instruments**

An instrument panel mounted on the engine shall be provided and shall comprise the following flush-mounted instruments and gauges:

- Lubricating oil inlet and outlet temperature

- Lubricating oil pressure gauge
- Tachometer, positive driven
- Hour counter.

c) Protection Devices

Warning indication and automatic shut-down shall be provided for the following:

- Low oil pressure shutdown and alarm
- Low and high coolant temperature alarm
- High coolant temperature shutdown
- Fail to crank shutdown
- Over cranking shutdown
- Over speed shutdown
- Low & high DC voltage alarm
- Low battery alarm
- Low fuel-day tank alarm
- High and Low AC voltage shutdown
- Emergency stop
- Failure indication lights and alarm for all fault conditions shall be provided on control panel for restoring the operation to normal.
- The starting circuit shall be disconnected in the event of any of the above shutdowns.

3.15 Alternator

3.15.1 The Alternator shall have the following characteristics

Type	-	Drip Proof Screen protected for power generation
Speed	-	1500 R.P.M.
Net Site Output	-	Rated continuous at ambient conditions and as per schedule of quantities.
Voltage Regulation	-	Within 0.5% of the rated voltage
Overload	-	Upto 10% of the nominal rating for 1 hour every 12 hours without exceeding permissible temperature rise.
Harmonics	-	Maximum 1% between phase and neutral and total maximum 3%

3.15.2 Construction

A screen protected drip proof type, alternator directly coupled to the Diesel Engine by a flexible coupling shall be provided. The combined engine alternator unit shall be mounted on a common rigid fabricated base frame. The alternator shall have its windings star connected with the neutral connection brought out to a separate terminal. The alternator shall fully comply with the latest Standard BS 2613 and BS 269 in respect of winding insulation and fast response to maintain steady voltage.

3.15.3 Rating and Regulation

The alternator shall be rated to deliver the rated output at 0.8 P.F. lagging, on a 3 phase 4 wire 415 volts 50 cycle system. The alternator shall be of the self regulated and self excited type. The alternator shall be provided with a static excitation system and the voltage regulation from no load to rated load shall be within 0.5% of rated voltage.

3.15.4 Alternator Insulation

The alternator should have class H insulation suitable to withstand tropical conditions.

4. GENERATOR CONTROL PANELS

- 4.1 The generator control panel shall have all necessary instruments and accessories for operation and control of the generating set. On sensing the utility mains voltage dip to below said voltage volts, the control panel shall send a signal to start the generator. After 5 successive start and if the diesel generator is not started up, the alarm signal shall be activated.
- 4.2 The Control Panel shall be Powder coated manufactured with 14 / 16 gauge CRCA sheet provided with following:
- Combined meter for KW, kVA and PF
 - KWh meter
 - Current transformers
 - Aluminum busbars of suitable capacity with incoming and outgoing terminations.
 - Indicating lamps for “DG On” and “Load On”
 - Instrument fuses/ MCB duly wired and ferruled.
 - Power Command or equivalent control panel for microprocessor based metering; monitoring & auto synchronizing control system(optional), AMF control panel, battery charger, remote/ auto start panel, auto/ manual synchronizing panel, audio/ visual annunciation for faults.
- 4.3 Operation of DG sets shall be monitored and controlled by a 32/64-bit microprocessor based for Automatic Mains Failure of mains and Bus couplers, Auto Changeover/ Interlocking, Auto Load Management Functions. Synchronization of DG Sets if required shall be provided by PCC-3 or equivalent DG Controller of DG Sets.

5. RADIO INTERFERENCE

All equipment provided under this specification shall be so designed that it will not cause interference with radio equipment. In the event of the inherent characteristics of the equipment being such that radio interference is possible, efficient devices to nullify the same shall be provided. Suppressers shall be as per the relevant I.S./B.S. Standards.

6. NOISE & EMISSION LIMITS

Noise and emission levels shall comply to the limits laid down in the currently Latest applicable norms issued by the concerned local Pollution Control Authorities.

7. ACOUSTIC ENCLOSURE

7.1 Certification

Design of acoustic enclosure shall guarantee the noise level at 1 m from the enclosure not to exceed 75 dBA. In addition, the design shall comply to applicable norms issued by Pollution Control Authorities. The design shall be certified by the engine manufacturer to be satisfactory for continuous operation of the DG sets without undue temperature rise or any other malfunctioning. Copy of manufacturers certificates shall be furnished alongwith a tender.

7.2 Construction

The weather proof acoustic enclosure provided for the silent DG sets shall be fabricated from minimum 2 mm thick CRCA sheets. The base frame of the enclosure shall be fabricated from ISMC sections fabricated from minimum 5 mm thick CRCA sheets. All hardware shall be high tensile grade. All joints shall be sealed with fire proof neoprene gaskets. The acoustic enclosure shall be of modular construction to permit easy assembly and dismantling and shall will designed for easy access to the serviceable parts of the DG sets. The access doors shall be neoprene gasketed The entire steel works shall be painted

with weather proof, acid proof, heat resistant powder coated paint finish of minimum 15 micron thickness which shall be applied after pre treatment for degreasing, de-rusting, pickling, phosphating and passivation in 7 tank process.

7.3 Sound Insulation

Acoustic insulation inside the enclosure shall be provided by means of suitable thickness of resin bonded fiberglass insulation of appropriate density, so as to achieve a maximum sound level of 75 dBA at 1m from the DG set.

7.4 Ventilation

The acoustic enclosure shall be provided with a ventilation system designed to restrict the temperature rise above ambient to 5° C. Supply air inlet and exhaust air outlet provided for the ventilation system shall be provided with acoustic louvers for sound attenuations.

8.0 BATTERY CHARGER

8.1 GENERAL

The battery charger shall be Float cum Boost type IGBT controlled. The charger shall have selector switch for Auto Float – Boost / Manual Float / Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost mode and Vice-Versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to trickle charge.

8.2 CONSTRUCTION FEATURE

The battery charger shall be housed in sheet steel cubicle of Angle Iron frame work with sheet steel panels of 1.6 mm thickness. Louvers shall be provided in the cabinet for the ventilation. The cubicle shall be painted in Siemens Grey shade RAL7032 of IS-5. Four wheels shall be provided at the base.

8.3 PERFORMANCE

8.3.1 The D.C output voltage of Float / Boost charger shall be stabilized within + 2% for AC input variation of 230 V + 10%, frequency variation of 50 Hz + 5% and DC load variation of 0-100%. The voltage regulation shall be achieved by a constant voltage regulator having fast response IGBT control. The ripple content will be within 3% of DC output nominal voltage.

8.3.2 There shall be provision to select Auto Float / Manual Float / Manual Boost modes. During Auto Float Mode the battery charging shall automatically changeover from Boost Mode to Float Mode and Vice Versa. During Manual Float / Boost modes it shall be possible to set the output volts by separate potentiometers.

8.3.3 The battery charger shall have automatic output current limiting feature.

8.4 COMPONENTS

8.4.1 The battery charger shall essentially comprise of the following

- a) 1 No. double pole ON/OFF MCB at AC input.
- b) 1 No. pilot lamp to indicate charger ON.
- c) 1 No. Main Transformer: Double wound, naturally air cooled, having copper winding.
- d) 1 set single phase full wave bridge rectifier consisting of 4 Nos. IGBTs, liberally rated, mounted on heat sinks and complete with resistor / condensor network for surge suppression.

- e) 1 No. rotary switch to select auto float / manual float / manual boost. During auto float mode automatic changeover shall take place from float mode to boost mode and vice versa.
- f) 1 set solid state constant potential controller to stabilize the DC output voltage of the float cum boost charger at + 2% of time set value for AC input voltage variation of 230 V + 10%, frequency variation of + 5% from 50 Hz and simultaneous load variation of 0-100% and also complete with Current Limiting Circuit to drop the Float Charger output voltage upon overloads to enable the battery to take over.
- g) 1 No. electronic controller to automatically changeover battery charging from boost to float and vice versa..
- h) 1 No. DC ammeter and toggle switch to read charger output current and battery charge / discharge current.
- i) 1 No. moving coil DC voltmeter to read the DC output voltage.
- j) 2 set potentiometer to adjust the output voltage during manual /auto float and boost modes.
- k) 2 No. double pole ON/OFF MCB at DC output, 1 No. at charger output and the other at load.
- l) 2 set DC output terminals. 1 set for the load and the other set for the battery.
- m) Alarm Annunciation : Visual and audible alarm with manual accept reset facility shall be provided for the following for BMS Connectivity
 - AC mains fail
 - Charger Fail
 - Load / Output overvolt.

8.5 Rating

AC Input	:	230 V + 10% AC 50 Hz single phase.
DC Output	:	To float / boost charge batteries and also supply a continuous load.
Current Rating	:	30.0 Amps
Float Mode	:	27.0 V nominal (Adjustable) between 24-28.0 V.
Boost Mode	:	29.0 V nominal (Adjustable) between 24-32.0 V.
Voltage Regulation	:	$\pm 2\%$ for AC input variation of 230 V $\pm 10\%$. Frequency Variation of 50 Hz $\pm 5\%$ and DC load variation 0-100%

9. EARTHING

2 nos. earth points, isolated through DMC insulator and connected to the alternator neutral and electrical panel body through flexible copper wires shall be provided at the side of the enclosure.

10. ENGINE MANUFACTURER'S APPROVAL

The design of the acoustic enclosure shall be specifically approved by the engine manufacturer for ensuring satisfactory engine performance and implementation of warranties.

11. FUEL OIL SYSTEM

Diesel oil shall be stored in day fuel tanks and fuel from the tanks shall be transferred to the individual DG sets by gravity flow.

11.1 Approvals & Clearances

- 11.1.1 The entire installation showing clearly the schematic arrangement, details of installation of tank, bill of material etc. shall be as per the requirements of the Department of Explosives following approval / clearances shall be obtained..
- 11.1.2 Before commencement of work - approval of shop drawing of the entire installation including bill of material etc shall be obtained from the Department of Explosives by the Contractor.
- 11.1.3 After commencement of work - Clearance of the installation for use by Engineer-in-Charge

11.2 Daily Service Fuel Tank

Day fuel tanks of 990 litres capacity shall be provided. The tank shall be fabricated from not less than 4 mm thick M.S. Sheet. A removable cover of ample size with lock shall be provided to permit access to the tank interior. The tank shall be provided with all required appurtenances like inlet and outlet connections, drain connection, overflow connection etc. Fuel level indicator with low and high level visual shall be provided. The day tanks shall be floor/wall supported on steel support 300 mm above FFL. Outlet valves from all storage tanks shall be located at easily accessible points so as to facilitate immediate shutting off of the fuel supply incase of emergency.

11.3 Pipes and pipe fittings

The MS pipes shall be of minimum class B (Heavy gauge) type. Makes of pipes and pipe fittings shall be as stipulated in the list of approved makes and as approved by Project Managers.

11.4 Earthing of oil storage & transmission system

All fuel oil pipe lines, valves, pumps, tanks and associated equipments shall be electrically continuous. The electrical continuity shall be checked and tested by suitable ohm meter and the test result recorded. Since the fuel piping specially the part directly buried in ground is provided with elaborate protective coating against corrosion, this continuity testing shall be carried out before application of the protective coating including the primer paint but immediately after installation of the piping system and its pressure testing. Since the continuity will not be available wherever there is a flanged joint because of insulated gasket in between, such joints shall be bonded to form a continuous electrical path and the entire pipeline shall be effectively connected to earth. For ensuring the tanker delivering oil to be also earthed, the 2 ends of the whole pipe shall be jointed through flexible cabling through effective clamping devices.

12. ENGINE AUXILIARIES AND WIRING

All engine auxiliaries shall be checked and tested for proper operation. Wiring between the engine auxiliaries and the DG control logic panel shall be provided with copper conductor PVC insulated 1100 V grade armoured cables. Loop earthing as required shall be provided.

13. GUARANTEED TECHNICAL PARTICULARS

Guaranteed technical particulars in format enclosed as Appendix-III of these specifications shall be filled in by the tenderer and enclosed **along with** the tender. Tenders not complying with these requirements are liable to be rejected.

14. EMISSION LIMITS FOR DIESEL ENGINES (UPTO 800 KW) FOR GENERRATOR SETS (GENSETS) APPLICATIONS

14.1 Emission Limits

The emission limits for diesel engines upto 800 KW, for gensets applications shall be as given below:

Capacity of Diesel Engines	Date of Implementation	Emission Limits (g/kw-hr) for				Smoke Limited (Light absorption co-efficient, m ⁻¹) (at full load)
		NOx	HC	CO	PM	
Upto 19 KW	1.4.2014	≤ 7.5	≤ 7.5	≤ 3.5	≤ 0.3	≤ 0.7
>19 KW upto 75 KW	1.4.2014	≤ 4.7	≤ 4.7	≤ 3.5	≤ 0.3	≤ 0.7
>75 KW upto 800 KW	1.4.2014	≤ 4.0	≤ 4.0	≤ 3.5	≤ 0.2	≤ 0.7

14.2 Acronyms Used

MW	:	Mega (10 ⁶) Watt
NO _x	:	Oxides of Nitrogen
NO ₂	:	Nitrogen Dioxide
O ₂	:	Oxygen
NMHC	:	Non-Methane Hydrocarbon
C	:	Carbon
PM	:	Particulate Matter
CO	:	Carbon Monoxide
SO ₂	:	Sulphur Dioxide
ppmv	:	Part per million (10 ⁶) by volume
FO	:	Furnace Oil
HSD	:	High speed diesel
LDO	:	Light Diesel Oil
LSHS	:	Low Sulphur Heavy Stock
kPa	:	Kilo Pascal
mm	:	Milli (10 ³) meter
kg/hr	:	Kilo (10 ³) gram per hour
mg / Nm ³	:	Milli (10 ³) gram per Normal metre cubic

14.3 Area Categories A & B are defined as follows:

Category A : Areas within the municipal limits of towns / cities having population more than 10 lakhs and also upto 5 km beyond the municipal limits of such towns / cities.

Category B : Areas not covered by Category A

14.4 The standards shall be regulated by the State Pollution Control Boards or Pollution Control Committees, as the case may be.

14.5 LIMITS OF NOISE FOR POWER GENERATING SETS (UPTO 1000 KVA) MANUFACTURED ON OR AFTER THE 1ST JANUARY, 2005

14.5.1 Applicability

These rules apply to Generator sets upto 1000 KVA rated output, installed on or after 1st January, 2005.

14.5.2 Requirement of Certification

Every manufacturer or importer of Power Generating set must have valid certificates of Type Approval and also valid certificates of conformity of production for each year, for all the product models being manufactured or imported after 1st January, 2005 with the specified noise limit.

14.5.3 All Power Generator shall have a valid Type Approval certificate and conformity of production certificate.

14.5.4 All Power Generator shall have conformance label meeting the requirements.

14.5.5 The conformance label shall contain the following information:

- a) Name and address of the supplier (if the address is described in the Owner's manual, it may not be included in the label).
- b) Statement "This product conforms to the Environment (Protection) Rules, 1986"
- c) Noise limit. 75 dB(A) at 1 m.
- d) Type approval certificate number.
- e) Date of manufacturer of the product.

14.5.6 Authorized agencies for certification

The following agencies are authorized to carry out such tests as they deem necessary for giving certificates for Type Approval and Conformity of production testing of Generator and to give such certificates:

- a) Automotive Research Association of India, Pune.
- b) National Physical Laboratory, New Delhi.
- c) Naval Science & Technology Laboratory, Palghat
- d) National Aerospace Laboratory, Bangalore

Specifications for Supply of D.G. Set with Acoustic Enclosure along with Accessories.

1) DG Set

Diesel Engine with Radiator Cooled, turbocharged with after cooler, suitable for prime duty Generating Set application, with an output of 750 kVA & 1010 under NTP conditions of BS:5514, with an overload capacity of 10% for one hour in every 12 hours of Operation.

The DG Set should be capable of voltage buildup within 15 to 20 seconds after receiving start command and it should be ready to take first step load within 15 to 20 seconds after receiving start command on voltage buildup.

2) DIESEL ENGINE:

The Engine shall be complete with the following accessories:

- The total No. of Cylinders is 6 Nos In-line type.
- Engine cubic capacity should not be less than 19 L.
- Full authority electronic engine
- In-Line fuel pump with electronic governing
- Radiator with blower fan
- Corrosion inhibitor / liquid coolant
- Spin-on filters-fuel & lube oil
- common rail electronic fuel system

- Plate type lube oil cooler
- Flywheel housing and flywheel to suit single bearing alternator.
- Dry type and replaceable paper element air cleaner with restriction indicator
- Standard integral set-mounted radiator system, designed and tested for 50°C ambient temperature.
- Optimized turbocharger for increase altitude capabilities
- Hospital Grade silencer
- Stainless steel exhaust flexible bellows
- Electric starters with soft start engagement features
- Battery charging alternator
- Anti-vibration mounts of reputed make.
- Protective guards for all rotating parts.
- Exhaust after-treatment and in-cylinder solution to meet stringent emission norms.

3) ALTERNATOR:

“STAMFORD”, or approved equivalent make standard design Alternator, suitably rated at 750 kVA/ & 1010 KW at 0.8 PF, 415 Volts, 3 Phase, 4 wires, 50 cycles/sec., 1500 RPM, self-excited and self-regulated, with brushless excitation, Band of Voltage Regulation + 1% of rated voltage, from no load to full load, Insulation Class “H”. The Alternator generally conforms to ISO:3046

- Brushless type, Screen protected, Revolving field, Self-excited alternator conforming to IS/IEC 60034-1
- Better motor starting capability.
- Best in class efficiency
- Compact design with sealed bearings for longer life and lesser maintenance
- Impregnation on all wound components for better mechanical strength

4) INTEGRATED DG CONTROLLER:

- Microprocessor based generator set monitoring, metering, and control system with LCD display.
- AMF Functionality
- Sync Compatible (Capable to accept external speed signal from 3rd party sync controller)
- Intuitive operator interface which includes LED backlit 128X64 pixel graphic display with tactile feel soft- switches & generator set status LED lamps.
- Engine Metering: Oil pressure, Engine temperature, battery voltage, Engine running hours.
- AC Alternator Metering: L-L Voltage and L-N Voltage, Current (phase and total), kVA (phase and total), Frequency, kWh, kW and kVA (phase and total), PF, Utility Voltage and Freq.
- Engine Protection: Low lube oil pressure, High/ Low coolant temperature, Battery Over/ Under/ Weak Volts, Fail to Crank/ Start, Sensor failure, Cranking lockout.
- AC Alternator Protection: Over/ Under Voltage, Over/ Under Frequency, Loss of AC Sensing, Over speed, Over Current.
- Data Logging: Engine Hours, Control Hours and up to 5 recent fault codes
- Configurable glow plug control
- 12/24 Volt DC operation
- Sleep mode
- Mod bus interface (RS485 RTU)
- In Power compatible (PC based service tool)
- Certifications - meets the requirement of relevant ISO, EN, Mil Std. and CE standards
- Maintenance due alarm based on Engine Run Time and due date.
- Exerciser scheduler

5) BASE FRAME

Sturdy, fabricated, welded construction, channel iron Base Frame for mounting the above Engine and Alternator. Required number of anti-vibrations mounting pads, charged battery, battery stand, battery charger and leads etc.,

6) FUEL TANK

Min 990 Liters capacity sub-base Fuel Tank complete with level indicator, fuel inlet and outlet, air vent, drain plug, inlet arrangement for direct filling.

7) EATS

EATS system should be supplied from the Engine Manufacturer with switch back architecture. It should be integrated control Module for Engine and EATS . It should be able to meet the stringent Emission norms .

8) DEF tank.

Min 139 Liters capacity DEF Tank complete with supply Module, temperature and level sensor and supply line from DEF tank to EATS system.

9) Telematics system

Telematics system should be standard scope of supply to capture DG parameter , lo parameter and address BMS request over RS485 interface. Device should be 4G compatible , Device should be compatible with all the controllers. It should create reports- Alters and warning message.

10) WARRANTY

The DG Set shall be guaranteed against faulty workmanship / poor material quality and against failures due to the same, for minimum of two years or 5000 Hrs of operation whichever is earlier, from the date of commissioning. Apart from this warranty, Critical components of the engine viz Crank shaft, cam shaft, connecting rod, cylinder head and cylinder Block should carry warranty of 5 years from manufacturing date of engine or 5000 Hours of running whichever is earlier. No compromise will be entertained on this clause. The warranty letter should be given from manufacturer of the engine not by assemblers or OEMs and any other agency. Any progressive component damage due to manufacturing defect of 5 critical parts also covered within this warranty.

In order to ensure timely service backup, in case of emergency, it is very essential that manufacturer Service office is available closest to the site to ensure timely service, apart from their respective Service Dealers. The tenderer should submit the toll-free number details in India for the engine manufacturer to ensure speedy service support.

11) Standard and compliance

Product offered should be in accordance to with the GSR 804(E) dated 03-11-2022 and MoEFCC notification No.Q-15017/05/20L2-CP and complied Latest Norms with the above standard. Latest COP certificate should be submitted to meet the GSR 804(E) without which tender will not be accepted.

Non-compliance any of the above specs/requirements should be clearly mentioned in the tender, point by point.

ANNEXURE - I

ABBREVIATIONS

The following abbreviations have been used in the accompanying specifications, and schedule of quantities.

- DG Stands for Diesel Generator
- GG Stands for Gas Generator
- G I Stands for Galvanized Mild Steel.
- Cu Stands for Copper
- M S Stands for Mild Steel.
- L T Stands for Low Tension.
- PVC Stands for Polyvinyl Chloride.
- AMP Stands for amperes.
- V Stands for Volt
- I S Stands for Indian Standards.
- IEE Stands for Institution of Electrical Engineers - London.
- NEC Stands for National Electrical Code.
- ACB Stands for Air Circuit Breaker.
- MCCB Stands for Moulded Case Circuit Breaker.
- S P Stands for Single Pole.
- D P Stands for Double Pole.
- TPN Stands for Triple Pole and Neutral.
- 4 Pole Stands for triple pole and neutral of same size as the phase conductor.

ANNEXURE – II

TECHNICAL PARTICULARS – DG SETS

(Technical particulars to be filled in by tenderers and enclosed along with the tender)

Sl. No	ITEM	To be filled in by Tenderer	
1.00	Diesel Generating Set		
1.01	Packager of DG Set		
1.02	DG set rating		
1.03	Prime Ratings of the DG set based on continuous operation at ambient temperature of 40 ⁰ C.		
1.04	Prime Ratings of the DG set based on continuous operation at ambient temperature of 45 ⁰ C.		
1.05	Deration factor based on continuous operation running at ambient of 40 ⁰ C.		
1.06	Deration factor based on continuous operation running at ambient of 45 ⁰ C.		
2.00	Acoustic Enclosure		
2.01	Overall dimensions (Length x Breadth x Height) to be furnished.		
2.02	Whether design of enclosure is approved by DG manufacturer? Copy of the approval to be enclosed.		
2.03	Whether the design of enclosure complies to the prevailing norms stipulated by Pollution Control Authorities?		
2.04	Temperature rise inside the enclosure at rated output in worst ambient condition (Temp. 45 ⁰ C)		
2.05	Sound level at 1 m from the enclosure with door closed.		
3.00	Diesel Engines		
3.01	Make		
3.02	Manufacturers Model No		
3.03	Type of Cooling – Radiator or Heat Exchangers		
3.04	Aspiration		
3.05	Air cleaner type.		
3.06	Fuel / Lube Oil Filter Type		
3.07	Governor type and Class of Governing		
3.08	Whether flexible coupling with guard provided		

SI. No	ITEM	To be filled in by Tenderer	
3.09	Typical fuel consumption in litres/hr		
	For _____ kVA		
	50% load		
	75% load		
	100% load		
	Fuel consumption figures vis-a-vis Alternator electrical output – Units/litre		
	50% load		
	75% load		
	100% load		
3.10	Lube oil consumption at 100% load		
3.11	Lube Oil sump Capacity to be declared		
3.12	Lube Oil change period to be declared		
3.13	Service interval period to be declared		
4.00	Alternator		
4.01	Make		
4.02	Rated voltage and frequency		
4.03	Enclosure		
4.04	Insulation class		
4.05	Exciter type		
4.06	Temperature Rise permissible.		
4.07	Voltage Regulation no load to full load		
4.08	Whether Space heater provided?		
4.09	Wave form distortion on full load		
4.10	Radio Interference		
4.11	Telephone Interference		
4.12	Stator winding thermistor with trip		
4.13	Deration factor based on continuous operation running at ambient temperature of 40° C.		
4.14	Deration factor based on continuous operation running at ambient temperature of 45° C.		
5.00	Instrument and Controls. Whether the following provided?		
5.01	Instruments :		
	Oil temperature gauge		
	Oil pressure gauge		
	Water temperature gauge		
	Battery charging ammeter.		
	Hour meter to show total engine hours run - 10,000 hr capacity		
	Digital R.P.M. indicator .		

SI. No	ITEM	To be filled in by Tenderer	
5.02	Operating Controls		
	Auto/manual switch		
	Emergency stop push button		
	Run/off – reset/auto engine start switch		
	Remote manual override with ON/OFF control		
5.03	Indication lamps		
	Emergency stop		
	Low battery voltage		
	Generator switch not in auto		
	Low lube oil pressure		
	System ready		
5.04	Safety controls		
	Low lube oil pressure		
	High water temperature		
	Over speed		
6.00	Exhaust system		
	Exhaust silencer type		
	Number of Silencers provided		
	Exhaust pipe diameter, material and thickness		
	Temperature of flue gases at exhaust manifold		
	Guaranteed Temperature on external face of exhaust pipe insulation		
	Exhaust stack height - along with back pressure calculation		
7.00	Tenderer to confirm including the cost of obtain following statutory approval.		
7.01	Electrical Inspector		
7.02	Electric Supply Authorities		
7.03	Pollution Control Board for emission and noise pollution		
7.04	Department of Explosives		
8.00	Lube Oil sump Capacity to be declared		
9.00	Lube Oil change period to be declared		
10.00	Service interval period to be declared		
11.00	BHP period to be declared		

Annexure-I.1

DG SETS – COST OF GENERATION

ITEM	Unit	Data shall be furnished by tenderer against each item	
Make of Engine			
Make of DG set			
Engine Model			
DG set rating	KVA		
DG set rating	Kw		
Average Load factor	%	75%	75%
Units generated per hour	kwh / hour		
Number of hours per year	hours / annum	2400 hours	2400 hours
Number of units generated per year	kwh / annum		
Fuel Cost			
Fuel rate	Rs per litre		
Fuel consumption	Litres/ hour		
Number of units per litre of Diesel	Kwh / litre		
Fuel cost	Rs per kwh		
Lub Oil Consumption Cost			
Lub oil consumption	litres / hour		
Cost of Lub oil	Rs per litre		
Lub Oil consumption cost	Rs per hour		
Lub Oil consumption cost	Rs per kwh		
Lub Oil Replacement Cost	Rs per litre		
Lub Oil replacement period	hours		
Lub Oil replacement quantity	litres		
Lub oil replacement	litres / hour		
Lub oil replacement cost	Rs / hour		
Lub Oil replacement cost	Rs per kwh		
Maintenance Cost			
"B Check" maintenance period	hours		
"B check" maintenance kit cost	Rs		
"B Check" maintenance cost	Rs per kwh		
"C Check:" maintenance period	Hours		
"C Check:" maintenance kit cost	Rs.		
"C Check" maintenance cost	Rs per kwh		
"D Check:" maintenance period	Hours		
"D Check:" maintenance kit cost	Rs.		
"D Check" maintenance cost	Rs per kwh		
Air Cleaner element change period	hours		
Air Cleaner Element cost	Rs		
Air Cleaner Element replacement cost	Rs per kwh		
Total Cost per kwh generated			

Annexure – 1.2**DG SETS – EMISSION LEVELS – at 100% Load**

ITEM	Emission level as per Pollution Control Board Norms+IV	Guaranteed emission level of the engine offered to be filled in by the tenderer	
NO _x	9.2 g/kW-Hr		
SO _x			
CO	5 g/kW-Hr		
HC	1.3 g/kW-Hr		
Dust (Particulate Matter)	0.5 g/kW-Hr		

Signature of tenderer

ANNEXURE-I.3**LIST OF APPROVED MAKES FOR EQUIPMENT & MATERIALS**

S. No.	Details of Materials / Equipment	Manufacturer's Name
1.	Diesel Engine	CUMMINS INDIA CATERPILLAR PERFECT HOUSE PERKINS
2.	Alternator	CATERPILLAR STAMFORD LEROY SOMER KIRLOSKAR BAUDOQUIN
3.	Fire Sealant & Fire Retardant Paint	BIRLA 3 M, HILTI PROMAT
4.	M.S. Pipe	JINDAL TATA STEEL ZENITH
5.	Vibration Isolators	EASYFLEX RESISTOFLEX
6.	Noise Control Silencer / Muffler (Residential Type Silencer)	INTERTEC SOUND CONTROL INDIA
7.	Fiberglass Insulation	OWENS CORNING UP TWIGA
8.	Glass Wool	ROCKWOOL
9.	Welding Rod	ADOR, ADVANI COSMOS, ESAB
10.	Batteries	AMAR RAJA EXIDE HBL LUMINOUS
11.	Battery Charger	AE AMAR RAJA CHABBI ELECTRICAL HBL LUMINOUS
12.	Butterfly valves	AUDCO ADVANCE NVR
13.	Gate/NRV/Check valves	AUDCO NVR ZOLOTO
14.	Strainers	EMERALD SANT

FIRE FIGHTING

TECHNICAL SPECIFICATION OFFIRE FIGHTING WORKS:

A. Technical Specification of DSR items of Fire Fighting works (Based on DSR E&M 2025/ Bank SOR) 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).

B. 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.

C. 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) Internal & External Fire Hydrant System.
- iii) Sprinkler system.
- iv) Hand Appliances (Fire extinguisher)
- v) Fire suppression system in Sever room & Electrical panel.

Without restricting to the generality of the foregoing, the work shall include the following: A Fire fighting System covering the entire complex and consisting of the following:

- (v) Three numbers of Pumps in Pump room & One no. of pump in Terrace – One number Main electric Horizontal type, multistage, centrifugal, split casing pump of 2280 LPM at 80 M head common for both Hydrant system & sprinkler system, one number a Diesel Standby Horizontal type, multistage, centrifugal, split casing pump for Hydrant System of 2280 LPM at 80 M head and Jockey Pump Horizontal type, multistage, centrifugal pump for System pressurization of 180 LPM at 80 M.head. Horizontal type, multistage, centrifugal, split casing Terrace pump of 900 LPM 35 M Head.
- (vi) Complete Internal Hydrant System (including Tapping from Pump, taking tapping at each floor along with Landing Valve and all Hydrant accessories complete shall be in scope of this work.
- (vii) Terrace Booster Pump, piping and its connectivity with each Hydrant Riser, Panel, Cabling etc. as complete system shall be this scope of work.

- (viii) External Hydrant System, External Hydrant Landing Valves, External Hose Cabinet (Wall / Floor Mounted), RRL Hose, Nozzle etc. complete shall be in this scope of work. Above ground / Buried Piping on required basis along with excavation filling and with necessary Testing Method as complete system shall be in this scope of work.
- (ix) Sprinkler Tapping, Installation Control Valve, Sprinkler Tapping at each floor along with Zone Control Valve, Sprinkler piping & Sprinkler Head, Braided Flexible pipe drop etc. as per the requirement as complete Sprinkler system shall be in this scope of work.
- (x) Sprinkler Annunciation Panels / Fire Alarm Panels along with necessary wiring / cabling till each floor shall be in this scope of work. (Sprinkler Annunciation panel shall be integrated with Fire Alarm System). Design, Supply, installation, testing, and commissioning of Local Flooding (Automatic gas suppression system) for panel protection (inside panel) & Room flooding (Automatic gas suppression system) for IBMS Server Room as applicable.
- (xi) The Contractor to get Fire NOC approval from statutory authorities, including taking out necessary number of prints of drawings, submission to accredited agency, coordinating site visits, making any minor modification in drawings for the purpose, etc. shall be in this scope of work.
- (xii) Supporting arrangements needed for the piping, valves and instrumentation, operating platforms /crossovers etc in pump house & all work locations of site shall be in this scope of work.
- (xiii) Performing and submitting Hydraulic calculations in Pipe-net Software shall be in contractors scope.
- (xiv) Radiography, Dye Penetrate Testing, Flushing Cleaning, Hydro/air testing, Holiday Testing for under Ground pipes etc. shall be in contractor's scope.
- (xv) After commissioning and taking over of the project by the Authority, the Contractor shall operate and maintain the entire project for a period as mentioned in tender including the Defect Liability Period (DLP) as mentioned in tender.
- (xvi) 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).

D. Contractor's Experience.

- Contractors shall engaged specialist agency only for this work of Fire Fighting systems.
- The selected specialist agency must have sufficient experience in the execution of turnkey projects as specified.
- 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.

E. Technical Information.

- Contractor shall submit along with the tender copies of detailed specifications, cuts, leaflets and other technical literature of equipment and accessories offered by him.

- 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.

a. Exclusions.

- I) Work under the contract does not include the following work.
- II) Electrical cable up to incoming motor control centre.

F. Site Accessibility.

- I) The equipment's are to be located in pump house located within the Service block.
- II) 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.
- III) Contractor must visit the site and familiarize himself with 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.

G. Approvals.

The contractor shall prepare all submission drawings and obtain all approvals of fire fighting works from fire fighting authorizes.

H. System Description.

- I) The Hydrant System shall comprise of AC motor driven pump set, standby diesel pump set, jockey pump set for pressurization and fire booster pump with all required accessories including valves, special fittings, instrumentation, control panels and any other components required to complete the system in all respects.
- II) The Hydrant System shall be **automatic** in action and shall be laid covering the entire area externally and all the floors internally with independent piping system for Sprinkler System, a separate piping system shall be installed.
- III) The Hydrant System shall be kept pressurized at all times. The proposed **Jockey** Pump shall take care of the leakages the system, pipe lines and valve glands.
- IV) The pressure in the hydrant pipe work shall be kept constant at 7 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. There shall be one Diesel Engine Driven pump as standby for both hydrant and sprinkler system. In case of failure of electricity or failure of Electric Pump to start on demand, the standby Diesel Pump shall automatically takeover. Minimum Pressure maintain in the hydrant system shall be 3.5 kg/cm²

- V) However, shutting down of the pump set shall be manual except for the Jockey Pump which shall start and stop automatically through pressure switches. In addition to auto start arrangements, the main pump shall also have an over-riding manual starting facility by push bottom arrangement.
- VI) The Internal Hydrant System (Wet Risers) shall be provided at points as indicated on the drawing on each floor.
- VII) The hydrant point shall be directly tapped from the Riser pipes, and shall be furnished with required accessories such as-

One no. gunmetal single headed hydrant valves. Two nos. RRL Hoses of size 63 mm dia x 15 meter long. One no. first aid hose reel 20mm dia x 30 meter long. One nos. Branch pipe.
- VIII) The hydrant risers shall be terminated with air cushion tank at the highest points to release the trapped air in the pipe work.
- IX) An overhead tank 25000 liters capacity will be connected to the fire hydrant system.
- X) Sprinkler system shall be distributed entire building so as to cover 9-12 sq.m area with one sprinkler. Sprinkler risers shall be provided with instantaneous control valve with alarm gang. An overhead tank of 25000 liters capacity with makeup line will be connected to sprinkler riser at. A suitable drainage arrangement with bye-ass valve shall be provided to facilitate maintenance of sprinkler pipe work.
- XI) 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 near 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.
- XII) The entire Wet Riser and Sprinkler system shall be fed from the Underground Water Tank of 175 KL.

GENERAL SPECIFICATIONS.

1.0 Main Fire Pumps

1.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers. Pump size shall be **2280 LPM & 80M** Head. Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

1.2 The centrifugal pumps shall conform to IS 1520.

a) The pump casing shall be of heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.

b) The impeller shall be of bronze, brass or stainless steel. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.

c) The shaft shall be of stainless steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump.

d) The shaft sleeve and ring etc. shall be of bronze, brass or stainless steel.

e) The bearings shall be ball or roller type suitable for the duty involved.

1.3 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.

1.4 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.

1.5 Pumps shall be provided with approved type of mechanical seals.

1.6 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.

1.6(a) The pump shall meet the requirements of the tariff advisory committee and unit

shall be design proven in fire protection services.

1.7 Motors for Electric Driven Pumps

1.7.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.

1.7.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.

1.7.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.

1.7.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.

1.7.5 Motors shall be designed for auto start system.

1.7.6 Motors shall be capable of handling the required starting torque of the pumps.

1.7.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

1.8 Operating Conditions for the Service Pumps

1.8.1

Fire Service Pump	Nos.	Cut in Pressure	Cut Out Pressure	Remarks
Jockey pump	One	6.5 kg/cm ²	7.0 kg/cm ²	To auto start and auto stop on pressure switch on air vessel to stop.
Main pump	One	6.0 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.

Diesel Pump	Fire	One	5.0 kg/cm ²	Push button manual	To auto start on pressure switch on air vessel and manual off.
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(The above ratings will be adjusted finally at the time of commissioning as per site requirement and final setting shall be kept as per approval of PMC/ Bank).

2.0 Diesel Fire Pump

2.1 Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

2.2 General

The diesel pump set shall be suitable for automatic operation complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

2.3 Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500/2900 RPM as specified in bill of quantities.

2.4 Fire pump

- a) The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2280 lpm as specified, developing adequate head 80M so as to ensure a minimum pressure of 3.5 Kg./cm² at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 7.0 Kg./cm² in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.
- b) The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal.
- c) The pump casing shall be designed to withstand 1.5 times the working pressure.

- d) Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

2.5 Diesel Engine

2.5.1 **Environmental conditions** - The engine shall be required to operate under the conditions of environment as specified.

2.5.2 **Engine Rating** - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended upto date.

2.5.3 **Engine Accessories** - The engine shall be complete with the following accessories: -

- (i) Flywheel dynamically balanced.
- (ii) Direct coupling for pump and coupling guard.
- (iii) Radiator with hoses, fan, coolant/ water pump, drive arrangement and guard.
- (iv) Corrosion Resister
- (v) Air cleaner, oil bath type/dry type
- (vi) Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- (vii) Pump for lubricating oil and lub. oil filter
- (viii) Elect. starting battery (2x12 v)
- (ix) Exhaust silencer with necessary pipe work

- (x) Governor
- (xi) Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).
- (xii) Necessary safety controls
- (xiii) Winterisation arrangement, where specified.

2.5.4 **Starting system** - The starting system shall comprise necessary batteries (2x12 v), 24 volts **84 Ah** starter motor of adequate capacity and axle type gear to match with the toothed ring on the flywheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The battery capacity shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

2.5.5 **Exhaust system** - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed to be taken out of the building as per statutory requirement. The Contractors are advised to see the drawing and site to assess the length of exhaust pipe required and its cost & installation included with cost of pump. The total backpressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

2.5.5 **Engine shut down mechanism** - This shall be manually operated and shall return automatically to the starting position after use.

2.5.6 **Governing System** - The engine shall be provide with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

2.5.7 **Engine Instrumentation** - Engine instrumentation shall include the following: -

- (i) Lub. oil pressure gauge.
- (ii) Lub. oil temperature gauge
- (iii) Water pressure gauge

- (iv) Water temperature gauge
- (v) Tachometer
- (vi) Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

2.5.8 Engine Protection Devices - Following engine protection and automatic shut down facilities shall be provided:-

- (i) Low lub. oil pressure
- (ii) High cooling water temp.
- (iii) High lub. oil temperature
- (iv) Over speed shut down.

2.5.9 Pipe work - All pipe line with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems, copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

2.5.10 Anti Vibration Mounting - Suitable vibration mounting duly approved by Engineer-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.

2.5.11 Battery Charger - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

3.0 Jockey Pumps

3.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers. Pump capacity shall be 180 LPM & 80M Head

Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

3.2 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.

- 3.3 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.
- 3.4 Pumps shall be provided with approved type of mechanical seals.
- 3.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.
- 3.6 The pump shall meet the requirements of the tariff advisory committee and unit shall be design proven in fire protection services.
- 3.7 Motors for Electric Driven Pumps**
- 3.7.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.
- 3.7.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- 3.7.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
- 3.7.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33° C ambient temperature. Motors shall conform to IS: 325.
- 3.7.5 Motors shall be designed for auto start system.
- 3.7.6 Motors shall be capable of handling the required starting torque of the pumps.
- 3.7.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.
- 4.0 Terrace Pumps**

- 4.1 Pumping sets shall be single/multi stage horizontal centrifugal single or multi outlet with cast iron body and bronze dynamically balanced impellers. Pump capacity shall be 900 LPM & 35M Head

Connecting shaft shall be stainless steel with bronze sleeve and grease lubricated bearings.

- 4.2 Pumps shall be connected to the drive by means of spacer type love-joy coupling, which shall be individually balanced dynamically and statically.
- 4.3 The coupling joins the prime mover with the pump shall be provided with a sheet metal guard.
- 4.4 Pumps shall be provided with approved type of mechanical seals.
- 4.5 Pumps shall be capable of delivering not less than 150% of the rated capacity of water at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.
- 4.6 The pump shall meet the requirements of the tariff advisory committee and unit shall be design proven in fire protection services.

4.7 **Motors for Electric Driven Pumps**

- 4.7.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors. For fire pumps, the motors should be rated not to draw starting current more than 3 times normal running current.
- 4.7.2 Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- 4.7.3 Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
- 4.7.4 Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be

designed for 33° C ambient temperature. Motors shall conform to IS: 325.

- 4.7.5 Motors shall be designed for auto start system.
- 4.7.6 Motors shall be capable of handling the required starting torque of the pumps.
- 4.7.7 Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

5.0 POWER AND CONTROL PANEL AND OTHER CONTROLCOMPENENTS.

5.1 Scope

This section covers the detailed requirements of the power and the control panel for the wet riser system, and also for the various control components in the system.

5.1.1 Power and Control Panel.

5.2 Constructional Requirements General Features.

The power and control panel shall be totally enclosed, free standing floor mounted cubic type, fabricated out of sheet steel not less than 2mm thick. Where necessary, additional stiffening shall be provided by angle iron frame work. General construction shall be of compartmentalization and sectionalisation such as mains incomes, electric fire pump, diesel fire pump, pressurization pump, and control, so that there is no mix up of power and control wiring and connections in the same sections as far as possible. The panel shall also have the space for cable allays. The space for cable alleys shall be at least 200m wide to the entire depth of panel. The panel shall be front operated type with all connections accessible from the front. Front doors shall be hinged type. Back doors shall be hinged type or removable type for inspection. The door hinges shall be of concealed type. The doors for bus bar chamber shall be of removable type with the help of bolts. The doors shall be provided with quick fixing doors knobs with indication. The general arrangement of the panel shall be got approved before fabrication the cubicle construction shall be to IP 21 asper IS: 2147.

5.3 Cable entries and gland plates.

All cable entries shall be through gland plates which are removable and sectionalized. Where heavy cable are brought in and terminated, suitable clamps shall be incorporated to relieve the stress on the glands due to the weight of the cable. Cable entries may be from top or bottom depending on the equipment layout and cable scheme as approved.

5.4 Bus bar and Connections.

The Bus bar shall be air insulated, and of aluminium of high conductivity electrolytic quality (grade E 91 E to IS: 5082) and an adequate cross section. Current density shall not exceed 1.3 amps. Per sq.cm. All connections to individual circuits from the bus bars shall preferably be with solid connections. The bus bars and the connections shall be suitably covered with PVC sleeves or in an approved manner. Bus bar shall be suitably supported using non-hygroscopic insulated supports. High tensile bolts and spring washers shall be provided at bus bar joints.

5.5 Earthing Arrangement.

GI strip 24mm x 5mm shall be run at the rate of the board 2 nos., earth terminals shall be provided at the ends of the GI strip for connection to earth system.

5.6 Terminal Blocks and Small Wiring.

Terminal blocks shall be heavy duty type and generally not less than 15 amps 250V grade up to 100V, and 600V grade for the rest of the functions. They shall be easily accessible for maintenance. All control wiring inside the panel shall be with PVC insulated copper conductor of 2.5 sq.mm size and 600V grade conforming to IS: 694- 1977. Suitable colour-coding may be adopted. Wiring harness shall be neatly formed and run preferably function wise, and as far as possible segregated voltage wise, Identification ferrules shall be used at both ends of the wires.

5.7 Instruments and Lamps.

All indication lamps and instruments shall be flush mounted type in front of the panel. The voltmeter and ammeter shall of size 100mm nominal (dial size) conforming to clause 1.5 of IS 1248 for accuracy.

Current transformers shall be provided with ammeters.

Indicating lamps to indicate the availability of electric supply shall be provided at the incoming section. Necessary indicating lamps for alarm indication and battery charging shall be provided in the respective sections.

All indicating lamps and meter shall be protected with HRC cartridge type fuses

5.8 Labels

All internal components shall be provided with suitable identification labels. Suitably engraved labels shall be fixed at the panel for all switches, instrument push buttons, indicating lamps etc.

5.9 Painting.

The entire panel shall be given a primer coat of red lead after degreasing and phosphating treatment and two coat of final paint or approved shade before assembly of various items.

5.10 **Equipment Requirements.**

5.10.1.1 **General**

The power and control panel shall comprises individual section for the various equipment's of the system and controls, in a combined cubicle type design. All switches MCCB. MCBS and fuse/fuses switch unit shall be conforming to relevant IS.

5.10.1.2 **Incomer Section & OutgoingSection.**

5.10.1.2.1 **Incomer section:**

1 no. 630 amps TPMCCB unit complete. One set of 96 mm square Ammeter (0- 630 Amps) complete with selector switch and CTS. One set of 96mm square Voltmeter (0-500 V) complete with control fuses and selector switch. One set of phase indicating lights with control fuses. One set of 4 strips of 300 Amps aluminium busbars.

5.10.1.2.2 **Outgoing Feeder.**

- (i) One number of 250 Amps TP MCCB unit complete, SP Preventer, ML 4 type contractor for star delta starting, start an stop push bottons, auto-manual switch, Ammeter with CTS, A S S , phase indicating lights. Auxillary Contractors for interlocking / sequence of operation, control terminals complete in all respect with interconnections for Hydrant Pump and sprinkler pump.
- (ii) One numbers of 125 Amps rated TP MCCB unit complete, ML 1.5 type contractor D O L starting with overload relay, start and stop button. Ammeter, CTS and selector switch, phase indicating lights, Auxiliary contacts for interlocking / sequence of operation, control terminals complete in all respect for Jockey Pump & fire booster pump.
- (C) Control wiring from pressure switches of different settings in Hydrant and Jockey Pumps, for sequence of operation shall be included to complete the system.
- (D) Colour code with ferrule marking shall also be make.
- (E) The wiring shall be PVC insulated and PVC armoured aluminium conductor cable of 650 /100 volts grade conforming to IS 1554 as required from Fire Pump Board to motor and cable of suitable size.

5.10.1.3 **Electric Fire Pump Section.**

This section shall incorporate the following facilities.

- a) MCCB
- b) Control system components and equipment such as relays,

contractors, timers etc. for automatic operation.

- c) Starter Unit , Current Transformer and ammeter.
- d) Indication lamps, their fuses, terminal block, push buttons, control and selector switches etc. are as required.
- e) Pump look out devices due to faults or abnormalities as specified in operating sequence.
- f) Visual/audio alarms, indications and communications facility as specified in operating sequence.
- g) Necessary inter-connection and control wiring etc.

5.10.1.4 **Engine Section.**

The engine section shall incorporate the following facilities:-

- i) Control system components and equipment such as relays, contractors, timers etc. for automatic operation.
- ii) Instruments, indicator lamps, fuses terminal blocks, push buttons, control and selector switches etc. as are required.
- iii) Engine shut down and block out devices due to faults or abnormalities as specified.
- iv) Visual/audio alarms and indications as specified.
- v) Inter-connection and control wiring etc.

5.10.1.5 **Auxiliary Pump Section.**

The auxiliary pump section for Jockey pump shall incorporate the following:

- a) TP&NMCBS
- b) Control system components such as relays, times, contractors etc. as are necessary for functional requirements.
- c) Starter unit, current transformer and ammeter.
- d) Indication lamps, fuses, terminal blocks, push buttons selector, switch etc. as required.
- e) Inter-connections and control wirings etc.

5.10.1.6 **Control Section.**

This section shall incorporate the following –

- a) Control components integrating the various sections, so as to satisfy the functional requirements.
- b) Battery charger unit with boost / float charge facility with voltmeter, capable of independently charging 2 sets of batteries at a time.
- c) Visual / audio alarms, not covered in individual sections.
- d) Lamps healthy test facility.
- e) Instruments, indicating lamps, pushbuttons, fuse terminal blocks etc. as are required.

- f) Test facility to simulate operation of hydrants.

6.0 FIRE BRIGADE INLET CONNECTIONS

- 6.1 Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified and as described in the BOQ, for the following purposes:
- i) Fire brigade inlet connection to fire static tank.
 - ii) Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of butterfly valve and Non return valve.
- 6.2 The locations of these Fire brigade connection shall be suitably decided with the approval of Consultant/Landscape Architect and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

7.0 FIRE BRIGADE DRAW CONNECTIONS

- 7.1 Fire Brigade draw connection shall be provided near the pump house as specified and as described in the BOQ, for the following purposes:
- i) Fire Brigade suction connection for fire static tank with provision of foot valve.
 - ii) Fire brigade draw out connection to the pump room system. Each connection shall be provided with similar dia of Butterfly valve and Non return valve.
 - iii) Fire brigade suction hose coupling (draw out connection) with nut for female coupling as per IS-902 complete with 100mm dia. Suction pipe and foot valve (to be connected to static tank) as per the drawing.
- The scope shall include providing necessary reducers, tees bends and special fittings as required. Necessary enclosure mad of 2mm thick sheet metal with support shall be provided, as in the case of hose cabinets.

8.0 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.

- 9.0 Masonry Chamber 90x90x100 cm inside, in brick work in cement mortar 1:4 (1 cement : 4 coarse sand) for sluice valve, with C.I. surface box 100 mm top diameter, 160 mm bottom diameter and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size), i/c necessary excavation, foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick, finished with a floating coat of neat cement complete as per standard design :With common burnt clay F.P.S.(non modular) bricks of class designation 7.5

10.0 INTERNAL HYDRANTS

- 10.1 The Internal Hydrant outlet shall comprise "Single Headed Single Outlet Gunmetal Landing Valve" conforming to type 'A' of IS:5290-1977. Separate valve on the head shall form part of the landing valve construction.
- 10.2 A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.
- 10.3 The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

11.0 EXTERNAL HYDRANTS

- 11.1 The **External** Hydrant outlet shall comprise "Single Headed Single Outlet Gunmetal Landing Valve" conforming to type 'A' of IS:5290-1977. Separate valve on the head shall form part of the landing valve construction.
- 11.2 A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.
- 11.3 The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

12.0 BRANCH PIPE

12.1 Branch pipes

Branch pipe shall be of Gunmetal or Aluminum alloy as given in BOQ 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

12.2 Nozzle

The nozzle shall be of Gunmetal, as specified in BOQ 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

12.3 End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

12.4 Two C.P hoses of 15m length and 63 mm dia with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length and 63 mm dia, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

13.0 ORIFICE PLATE

13.1 Orifice plate made out of 6 mm thick stainless steel (Grade 304) with orifice of required size to be fitted between flange & landing valve of external and internal hydrants to reduce pressure at the outlet to the level of 3.5 kg/cm² complete as required.

14. HOSE PIPES

14.1 Hose pipes

14.1.1 Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall conform to type B (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.

14.1.2 Each run of hose shall be complete with necessary coupling at the ends to match

with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS:903.

15. FIRST-AID HOSE REEL EQUIPMENT

- 15.1 First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall confirm to IS:1532-1969.
- 15.2 The hose tubing shall be 20 mm dia and 36.5m long. The G.M nozzle 5mm and globe valve shall be of 20 mm size.
- 15.3 The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS:884 - 1969. The first-aid hose reel shall be connected directly to the M.S. pipe riser taken independently from ring.

16.0 INTERNAL HOSE CABINET

- 16.1 The internal hose cabinet shall accommodate the Hose Pipes – 2 nos, Branch Pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge M.S/aluminum sheet as specified in Bill of Quantities. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening (cam lock) glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.
- 16.2 The hose cabinet shall be painted red and stove enameled and words FIRE written in front glazed portion.

17.0 EXTERNAL HOSE CABINET

- 17.1 The external hose cabinet shall accommodate the Hose Pipes, Branch Pipe, shall be fabricated from 2 mm thick or 14 mm gauge M.S/aluminum sheet as specified in Bill of Quantities. The overall size shall be 900x600x500 mm, or as specified in the Architectural details. This shall have lockable centre opening (cam lock) glazed

doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

- 17.2 The hose cabinet shall be painted red and stove enameled and words FIRE HOSE written in front glazed portion.

18.0 FIRE MAN AXE

- 18.1 Stainless steel standard fireman's axe with heavy insulated rubber handle tested to 20000 volts as per IS : 926

19 PIPES

19.1 All pipes within and outside the building in exposed locations and shafts including connections above ground / buried on required basis under floor shall be M.S. Pipes as follows:

- 19.1.1 Pipes 150 mm dia and above ground /below IS: 1239 Heavy Class

- 19.1.2 Pipe 200 mm dia and above IS 3589 of thickness specified.

19.2 PIPE FITTINGS.

19.2.1 Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality.

19.2.2 Fabricated fittings shall not be permitted for pipe diameters 50 mm and below.

19.2.3 When used, they shall be fabricated, welded and inspected in workshops under supervision of Project Managers whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

19.2.4 (a) M.S. Fittings(40 mm dia. and below shall be Forged Steel fittings as per ASTM A 105 3000CL, end connection Socket welded as per ASME B16.11. & one side socket

weld and other side threaded as per NPT for fittings used for sprinklers

- (b) M.S. Fittings of 50 mm dia & above shall be as per ASTM A 234 Gr. WPB all fittings shall be BW seamless fittings type as per specifications.

19.3 JOINTING

19.3.1 Screwed (50 mm dia pipes and below)

Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed MS forged fittings)

19.3.2 Welded (65 mm dia and above)

Joints between MS pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to X Ray test from an approved agency as per the TAC norms at the cost of contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase of required current and capacity.

19.4 Flanges.

Flanged joints shall be provided on:

- a) Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- b) Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- c) For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.
- d) Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of GKW make or equivalent with 3 mm insertion neoprene gasket complete.

19.5 Unions

Provide Approved type of dismantable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

20.1 PIPE PROTECTION

- 20.1 All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.
- 20.2 All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/MAKPOLYKOTE over the pipe, as per manufacturers specifications.
- 20.3 Proposed pipe for External firefighting is MS pipe (Mild steel pipe). Provide dimension tolerances, acceptance test, jointing, installation and testing process.

20.2. PIPE SUPPORTS

- 20.2.1 All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.
- 20.2.2 Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

20.3. TESTING

- 20.3.1 All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 Kg/Cm² without drop in the pressure for at least 2 hours.
- 20.3.2 Rectify all leakages, make adjustment and retest as required.

20.4. ANCHOR BLOCK

- 20.4.1 Contractor shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

21.00 Butterfly valve of PN 1.6 rating with bronze/gunmetal seat duly ISI marked

complete with nuts, bolts, washers, gaskets conforming to IS 13095.

22.0 Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

23.0 Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves upto 65mm shall be of Gunmetal Fullway Valve

with wheel tested to 20 Kg./cm² class-II as per I.S: 778-1971. Valve wheels shall be of right- hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing. Pump room Valve shall be with tamper switch. EPDM rubber gasket shall be used.

24.0 Gun metal gate valve with C.I. wheel of approved quality (screwed end)

25.0 Y-strainer fabricated out of 1.6 mm thick stainless steel, Grade 304, sheet with 3 mm dia holes with stainless steel flange.

26.0 25mm dia screwed inlet cast iron single acting air valves on all high points in the system or as shown on drawings.

27.0 Pressure Gauges.

Burden type pressure gauges conforming to IS/BS specifications shall be provided at the following locations.

- a) Just above alarm valve.
- b) Just below alarm valve, on the installation stop valve.
- c) One pressure gauge on delivery side of each pump.
- d) Required number of pressure gauges on pressure tank.
- e) **One on terrace and one on ground floor.**

28.0 Installation Control valve.

Installation control valves shall comprise of the following:

- a) One-man stop valve of full way pattern with gunmetal pointer to indicate where open/shut.
- b) One automatic alarm valve fitted with handle & cover.
- c) One hydraulic alarm motor and going for sounding a continuous alarm upon out-break of fire. One combined waste and testing valve including 5 mtr. of tubing and fittings.
- d) Alarm stops valve.
- e) Strainer

- f) Drainplug.
 - g) Padlock and strap
 - h) Wall box for installation of valve.
- 29.0 Air vessel made of 250 mm dia, 8 mm thick MS sheet, 1200 mm in height with air release valve on top and flanged connection to riser, drain arrangement with 25 mm dia gun metal wheel valve with required accessories, pressure gauge and painting with synthetic enamel paint of approved shade as required. It shall be paint with Post office red color as per the direction of Engineer -in-charge of PMC and employer
- 30.0 Reinforced neoprene rubber vibration eliminators / expansion joints (to provide relief from stresses at pipe flanges) suitable for upto 20 kg/cm² pressure
- 31.0 MS air vessel tank in Pump room fabricated from 6mm thick MS plate, 450 mm in diameter and 2 m in height with dished ends fabricated from 8mm thick MS plate with Air release valve with stop cock, flanged inlet connection and drain arrangement with 25mm dia valve, pressure gauge with gun metal stop cock complete with all accessories as required and conforming to IS 4736-1968. It shall be paint with Post office red color as per the direction of Engineer -in- charge of PMC and employer
- 32.0 Flow Switch in following 150mm sizes M.S. pipe including connection etc as required.
- 33.0 Inspectors test assembly complete with test valve, sight glass sectional drain valve, union with corrosion resistant orifice
- 34.0 **CABLES**
- 34.1 Contractor shall provide all power control cables from the motor control centre to various motors, level controllers and other control devices.
- 34.2 Cables shall conform to IS: 1554 and carry ISI mark.
- 34.3 Wiring cables shall conform to IS 694.
- 34.4 All power and wiring cables shall be aluminium conductor PVC insulated armoured and PVC sheathed of 1100 volts grade.
- 34.5 All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 Volt grade.
- 34.6 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

- 34.7 All cables joints shall be made in approved manner as per standard practice.
- 34.8 The cable jointing shall be Crimping type.
- 35.0 6 SWG dia G.I. wire on surface or in recess for loop earthing

36.0 CABLE TRAYS

- 36.1 Contractor shall provide G.I. perforated cable trays at locations as shown on the drawings and of sizes as given in the bill of quantities, with G.I. sheet thickness of 1.5mm.
- 36.2 Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by welding support rods with insert plates OR Anchor fasteners.
- 36.3 Cost of clips, bolts, nuts, support rods and any other materials required to fix the trays in proper manner shall be included in the rate for trays.

37.0 EARTHING

- 37.1 There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armour clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.
- 37.2 Earth plates shall be buried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centres. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.
- 37.3 A brick masonry manhole 30x30x30xcm size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated, in this manhole for testing.

38.0 SprinklerSystem. (Sprinkler system should be UL Listed & FM approved)i) **Sprinkler Heads.**

Sprinkler heads shall be of quartzoid bulb type with bulb, 68 degree centigrade temperature rating and K factor 80. The sprinklers shall be approved make and type. 93 degC will be use in the pantry area. 15 NB, with 68°C. temperature rating for Sprinkler bulb and 57°C. for Cover Plate, K 5.6 (80), Pendant type, Standard Response, Quartzoid bulb sprinkler adjustable royal flush Concealed sprinkler, teflon tape, lock tite solution with required accessories etc. complete. 15 NB, 93 deg. K 5.6 (80), Pendant type, Standard Response, Quartzoid bulb sprinkler, teflon tape, lock tite solution with required accessories etc. complete

ii) Types**Conventional Pattern.**

The sprinklers shall be designed to produce a spherical type of discharge with a portion of water being thrown upwards to the ceiling side of wall extra. The sprinklers shall suitable for erection in upright position or pendant position.

Pendent type Sprinklers.

These shall be designed for installation along with the ceiling.

Upright type Sprinklers.

These shall be designed for installation where false ceiling height more than 800mm.

Sprinkler annucation panel required to configure

with Flow switch Spare sprinkler MS cabinet is

required

Construction

- i) **Bulb** – Bulb shall be made of corrosion-free material strong enough to with stand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches a predetermined level.
- ii) **Valve assembly** – Water passage of the sprinkler shall be controlling assembly of flexible construction. The valve assembly shall be held in position by the quartzoid bulb. The assembly be stable and shall withstand pressure surges or external vibration without displacement.

- iii) **Yoke:** The yoke shall be made of high quality gunmetal. The arms of yoke shall be so designed as to avoid interference with discharge of water from the deflector. The sprinkler body shall be coated with an approved anticorrosive treatment if the same is to be used in corrosive conditions.
- iv) **Deflector :**The deflector shall be suitable for either upright or pendent erection. The deflector shall be designed to give an even distribution of water over the area protected by each sprinkler.

- **Colour Code.**

The following colour code shall be adopted for classification of sprinkler according to nomination temperature ratings.

- **Sprinkler Temperature Rating.**

- **Size of Sprinklers Orifices.**

The sprinklers shall be of 15mm nominal bore size.

39.0 Sprinkler flexible pipe (UL / FM Listed) of stainless steel complete with 15 NPT on reducer thread with maximum working pressure of 175 PSI test pressure of 875 PSI (Burst) with branch line (Inlet) 25mm NPT male thread to sprinkler head (Outlet) 15mm NPT female thread with reducer, nipple, 2 side brackets, center bracket, stockbar

40.0 Rosette plate for 15mm dia in white finish UL Listed or FM approved.

PORTABLE FIRE EXTINGUISHER

Portable fire extinguishers shall be provided as per Bill of Quantities and shall conform to IS:15683

41.0 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.

42.0 4kg 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 45 powder (Mono Ammonium Phosphate) pressured by Nitrogen complete in all respects including wall suspension bracket and conforming to IS:15683

43.0 2 KG Clean Agent (Stored Pressure Type) Fire Extinguishers filled with Clean Agent Gas', Nitrogen Pressurised, Controllable Discharge

- Mechanism, Pressure Gauge, Discharge Hose (for 4 & 6kg) & Nozzle Epoxy Polyester Powder Coated As per 'IS 15683 : 2018' ISI marked Fire Extinguisher Operating Temperature:- (-)20°C to (+)55°C Suitable for 'A' 'B' 'C' Class of FIRE suspension bracket and conforming to IS:15683 as required as per specifications. (Electrical Panel room & Server room)
- 44.0 Water type fire extinguisher 9 litre capacity cartridge type Mild Steel Cylinder filled with pure water and chemicals and cartridge filled with co₂, squeeze type, ISI marked(IS 15683) and accessories as per IS 15683
- 45.0 control panel for Terrace Booster pumps .
Incoming: MCCB 125A 1 set of Phase indicating lamps, 1 set of 125A Al bus bars, 3No Ammeter, 3No Voltmeter with phase selector switch Feeder for Booster Pumps - 2 No. 2 No. 50A TP MCCB without releases. DOL starter with over load relay, single phase preventor and indicating lamps with ON/OFF push buttons. 2 No. Automanual selector switch. Suitable for 2 nos. of booster pumps
- 46.0 Tamper switch for pump room valve complete with nuts, bolts, washers, gaskets in the pump room sluice valve.
- 47.0 Direct Low Pressure Pre-Engineered Automatic FK-5-1-12 (equivalent to Novec-1230) (UL Listed) Fire Detection & Suppression System with UL approved tube, UL & PESO approved Filling Plant, CE certified system, Cylinder, Pressure Gauge, other accessories as & if required Valve, Pressure Switch, Push-in tube connector
- 48.0 PESO approved seamless Cylinder (IS 7285) with PESO approved Valve assembly. FM approved & UL-Listed Clean Agent Fire Suppression System FK-5112 for following room at 25 bar pressure with pressure gauge, safety burst filled with FK-5112 at 4.5% concentration as per flow calculation report. Discharge time should be less than 10 seconds. Seamless pipe Sch 40 Gr 'B" , cylinder heads, valves, Safety burst disc, nozzles all necessary accessories, Electrical actuator, Manual actuator, Discharge Hose, cylinder clamp and fittings.
Gas suppression system is working when any spark happen it will activate the nozzle to emith the Gas FK-5112

50.0 Pipe Supports

All pipes shall be adequately supported from ceiling or walls from structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats. All clamps shall be painted with one coat of primer and two coats of black enamel paint. The contractor shall provide inserts at the time slab casting or anchor fastener later.

51.0 Testing.

- **Testing on Completion of Installation.**

The entire system shall be tested after completion of installation as per the operating sequence specified as per IS standard and codes.

Standard and Codes.

1.	IS-1648-1961 building(general)	Code of Practice for fire safety of Fire fighting equipment and maintenance.
2.	IS-3844-1966 fire	Code of practice for installation of internal hydrant in multi-storied building.
3.	IS-2217-1963	Recommendation for providing first aid and fire fighting arrangement 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
12.		Extinguisher soda acid type.
	IS-2873-1969	Specification for fire extinguisher for carbon dioxide.
13.	IS-2189 & 2109	Automatic fire alarm system or BSS-3116
14.	IS-15105:2021	Automatic sprinkler System

SECTION 3 TECHNICAL DATA SHEET FOR FIRE FIGHTING SYSTEM

1. It is the sole responsibility of the contractor to select the pump/motor to meet the requirements specified in the tender. Contractor is asked to fill up all the datas given below.

1. Fire Hydrant & Sprinkler System.

1.1 Pumps	Elec. Driven Fire	Diesel Driven	Jockey Pump Pump	Pump
1.1.1 Makes				
1.1.2 Model No.				
1.1.3 Rated Discharge (LPM)				
1.1.4 Rated Head (M)				
1.1.5 Speed (RPM)				
1.1.6 No. of Stages				
1.1.7 Efficiency at rates Capacity & head				
1.1.8 KW required at rated Capacity & head				
1.1.9 KW required at 150% Rated discharge				
1.1.10 Shut off head (M)				
1.1.11 Material of Construction				
a) Body				
b) Impeller				
c) Shaft				
1.1.12 Whether pump is capable of discharging 150% of rated capacity at a head not less than 65% of rated head.				

1.1.13 Whether Automatic Priming Arrangement included.				
1.2 Pipes				
1.2.1 Make				
1.2.2 Standard/Class				
1.2.3 Thickness				
1.2.4 Painting details for above ground & exposed pipes				
1.2.5 Wrapping & coating				
1.2.6 Whether ISI marked				
1.3 Fittings	Forged Fittings	Butt welded Fittings (up to 50 mm dia)	(65 mm dia & above.)	
1.3.1 Type				
1.3.2 Make				
1.3.3 Material				
1.3.4 Type of ends				
1.3.5 Pressure rating				
1.3.6 Whether ISI marked				
1.4 Valves	Butterfly	Sluice	Ball valve	
1.4.1 Make & Type				
1.4.2 Type of ends				
1.4.3 Material of construction				
1.4.4 Test Pressure				
1.4.5 Provided with all				

Accessories including gear system as per relevant IS				
1.4.6 Whether ISI marked/ TAC approved				
1.5 Engine/Motors	Engine	Main Pump	Jockey Pump	
1.5.1 Make				
Type & Model No				
1.5.2 Frame Size				
1.5.3 Speed (RPM)				
1.5.4 Rated Cap. (KW)				
1.5.5 Efficiency (%)				
1.6 Control Panel (MCC)				
1.6.1 Manufacturer				
1.6.2 Dimensions				
1.6.3 Type of construction & mounting				
1.6.4 Sheet Metal Enclosure				
a) Material				
b) Thickness				
1.6.5 Electrical Rating				
1.6.6 Make of starters/ Contactors				
1.6.7 Rating of Contactors				
1.6.8 Size & material of Bus bar				

1.6.9	Annunciation system			
1.6.10	Approx. weight			
1.6.11	Painting details			
1.6.12	Whether all equipment/ Components as per Specification included			
1.7	Dual / Disk Type Non Return Valves			
1.7.1	Make & Type			
1.7.2	Type of ends			
1.7.3	Material of construction			
1.7.4	Test Pressure			
1.7.5	Provided with all Accessories including gear system as per relevant IS			
1.7.6	Whether ISI marked/ TAC approved			
1.8	G.M. Ball Valve			
1.8.1	Make & Type			
1.8.2	Type of ends			
1.8.3	Whether confirm to to & marked IS:778			
1.9	Hydrant Landing Valve			
1.9.1	Make & Type			
1.9.2	Material of construction			
1.9.3	Details of Flange			

O.D. (MM)				
P.C.D (MM)				
No. of Holes				
1.9.4 Whether ISI marked/ TAC approved				
1.10 Hose Pipes	C.P. Hose	RRL (Type A)		
1.10.1 Make				
1.10.2 Test Pressure				
1.10.3 Dia (MM)				
1.10.4 Length (M)				
1.10.5 Material of couplings				
1.10.6 Where hose & Couplings ISI marked				
1.11 Branch Pipes & Nozzles				
1.11.1 Make				
1.11.2 Material				
1.11.3 Dia. of Coupling				
1.11.4 Dia of Nozzle				
1.11.5 Where ISI marked				
1.12 Hose Cabinet				
1.12.1 Size				
1.12.2 Material				
1.12.3 Thickness of sheet				

1.12.4 Thickness of glass				
1.12.5 Whether Rubber Gasket Provided				
1.12.6 Painting Details				
1.13 First Aid Hose Reel				
1.13.1 Make & Material				
a) Drum				
b) Hose				
1.13.2 Size of Drum (Dia x length)				
1.13.3 Size of Hose (Dia x length)				
1.13.4 Hose test pressure				
1.13.5 Size & material of Nozzle				
1.13.6 Size & material of Shut off valve				
1.13.7 Whether complete unit strictly confirms to and marked IS:884 TAC approved				
1.14 Pressure Switch				
1.14.1 Make & Type				
1.14.2 Type of ends				
1.14.3 Test Pressure				
1.14.4 Electrical Rating				
1.14.5 Whether ISI marked/				

TAC/UL approved				
1.14.6 Whether complete with gland or other accessories				
1.15 Pressure Gauge				
1.15.1 Make & Type				
1.15.2 Dial size (mm)				
1.15.3 Range (kg/cm.sq.)				
1.15.4 Whether ISI marked/ TAC/UL approved				
1.16 Flow Switch				
1.16.1 Make & Type				
1.16.2 Pressure Rating				
1.16.3 Electrical Rating				
1.16.4 Whether ISI marked/ TAC/UL approved				
1.1 Sprinkler Head	Conventional Pendant	Side wall	Concealed	
/ Upright				
1.1.1 Make				
1.1.2 Material				
1.1.3 Type of sensing Element & temperature Rating (C)				
1.1.4 Orifice size (MM)				

1.1.5 Type (UPRIGHT/PENDENT/ CONVENTIONAL/SIDEWALL /EXTENDED RANGE)				
1.1.6 Whether listed /				
Approved by UL/FH				
1.2 Wet Alarm Valve				
1.2.1 Make				
1.2.2 Material				
1.2.3 Size (MM)				
1.2.4 Whether provided with electric bell, test valve, drain valve, & all other training connections				
1.2.5 Whether approved hydraulic alarm motor & gong provided				
1.2.6 Whether valve & alarm Motor & gong listed/ approved by UL/FM/FOC/TAC				

SECTION IV**LIST OF APPROVED MAKES OF MATERIALS FOR FIRE FIGHTING WORKS**

S.No	Materials	Brand
1	MS Pipes	TATA / JINDAL / JSW /HISSAR
2(a)	Forged Steel Fittings	JSI / VS FORGE
(b)	Butt Welded Fittings	JSI / VS FORGE
3.	Gunmetal Ball Valves	KIRLOSKAR / L & T / SHAH BHOIGILAL
4.	C.I. Double flanged sluice Valves & check valves	KIRLOSKAR / L & T / SHAH BHOIGILAL
5.	Slim Seal Butterfly Valve, Gate Valve, Air Release valve	KIRLOSKAR / L & T / SHAH BHOIGILAL
6.	Dual/Disk type Non Return Valves	KIRLOSKAR / L & T / SHAH BHOIGILAL
7.	Fire Hydrant Valves, Branch pipe & Fire man Axe.	SHAH BHOIGILAL / NEWAGE / SAFEX
8.	Fire Aid Fire Hose Reels	SHAH BHOIGILAL / NEWAGE / SAFEX
9.	RRL Hose Pipe	SHAH BHOIGILAL / NEWAGE / SAFEX
10.	Sprinkler Head & Flexible drop	TYCO / HD / NEWAGE
11.	Fire Pumps	KIRLOSKER / CROMTON GRIVES / MATHER+PLATT
12	Motors	KIRLOSKAR / SIEMENS
13	Electrical Switch Gear	L&T / SIEMENS
14	CABLES	L &T/ FINOLEX/ HAVELS
15	Flow Meter	SANT/ KENT
16	Suction Strainer	DASMESH/ SANT/ ZOLOTO
17	Vibration Eliminator Connectors	RESISTOFLEX/ KANWAL
18	Single Phasing Preventor	SIEMENS/MINILEC/L&T
19	Pipe coat material	PYPKOTE/COALTECK
20	Flow switch	POTTER / SYSTEM CENSOR / JOHNSON CONTROL
21	Diesel Engine	ASHOK LEYLAND / KIRLOSKAR /CUMMINS / TAC Approved
22	Main control panel	APPLICATION CONTROL PANEL / SK POWER SOLUTION as IS STANDARD MAKE
23	Fire brigade inlet.	EXFLAME / NEWAGE / KALPEX
24	Rubber Hose pipe	SHAH BHOIGILAL / NEWAGE /

		SAFEX
25	Hose Couplings branch	SHAH BHOGILAL / NEWAGE / SAFEX
26	Pressure Switches	INDFOSS/SWITZER
27	Pressure Gauge	H.GURU/FIEBIG
28	Battery	EXIDE/ PRESTOLITE
29	Fire Extinguisher	SAFEX / NEWAGE / MINIMAX
30	Enamel paint	ASIAN / NEROLAC / BERGER
31	Annunciation panel	SAFEWAY / AGNI
32	Alaram Valve	MATTER & PALET / HD
33	Contactora	L& T / SIEMENS
34	Trimbles/Ferrules Tinned Copper	DEWEL
35	Cable gland.	COMMEX / POWER / GRIPWELL
36	Power Capacitor	L&T / CROMPTON / ASIAN
37	Measuring Meter	L&T/SIEMENS/AE
38	MS Conduit	STEEL CRAFT/BEC/AKG
39	Dash Fastener	HILTI FISHER
40	Paint Primers	ASIAN/ JENSIAN/ NICHOLSON
41	Weld Electrodes	ADVANI/ESAB/VICTOR
42	Pipe Hangers	CHILLY / BUILD TECH
43	Clean Agent based Fire suppression (FK-5112)	Viking Minimax (Germany)/ sevo/ Siemens/ Honeywell/ Corpusa
44	Installation Control Valve	HD Fire/ Tyco
45	Test assembly	HD Fire/ Tyco
46	Thermal insulation for Exhaust Pipe	UP Twiga/ Lloyd Insulation/ Kimmco
47	Underground Pipe protection Wrap	Pypcote/ Tapex/ Rustfire
48	Ductile iron Pipe	Electro steel/ Neco/ Ianco
49	Welding rods	Advani/ L&T/ ESAB/ Ador
50	Tamper switch for Sluice valve	Honeywell/ Potter/ rapid
51	Footvalve with Strainer	Kirloskar/ Normex/ Kartar
52	Air Vessel	Nema/ Zenith / Equivalent
53	Flow Test metre	Viking/ Newage/ Eureka Forbes
54	EWlectrical Actuator	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
55	Manual Actuator	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
56	Pneumatic Actuator	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
57	Discharge Hoses	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax

58	Actuation Hoses	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
59	Manifold Check valves	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
60	Nozzles	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
61	Low Pressure switch	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
62	Nitrogen Pilot cylinder and valve assembly & Pressure gauge	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
63	Discharge Pressure switch	Ansul/ tyco/ UTC/ Siemens/ Honeywell/ Viking/ Minimax
64	Seamless pipe for clean agent	Indian Seamless/ Maharashtra Seamless