GOLD SUNSHINE AGRO TECH SERVICES PVT. LTD.

Tender Ref No. 2004/RFP/2023

TENDER FOR THE WORK OF CONSTRUCTION OF BREEDING AND MILK PROCESSING PLANT AT VILLAGE NEER, DISTRICT HARDOI, UTTAR PRADESH

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS FOR CIVIL WORKS

CONTENTS

SPECIFICATION FOR WORK

GENERAL NOTES

I. The detailed specifications given hereinafter are for the items of works described in the schedule of quantities and shall be guidance for proper execution of work to the required standards.

II. It may also be noted that the specifications are of generalized nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings. The work also includes all minor details of construction which are obviously and fairly intended and which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.

III. Unless specifically otherwise mentioned, all the applicable codes and standards published by the Bureau of Indian Standards and all other standards which may be published by them before the date of receipt of tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc. Wherever any reference to any Indian Standard Specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued thereto or revisions thereof, if any, up to the date of receipt of tenders.

IV. In case there is no I.S. specification for the particular work, such work shall be carried out in accordance with the general guidelines of manufacturer/specialized agency subject to full satisfaction and approval of the Engineer-in-Charge.

V. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.

VI. Samples of various materials, fittings etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

VII. The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.

VIII. The contractor shall maintain in perfect condition all works executed till the completion of the entire work awarded to him. Where phased delivery is contemplated, this provision shall apply to each phase.

IX. The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

X. The contractor shall clear the site thoroughly of all scaffolding materials and rubbish etc. left out of his work and dress the site around the building to the satisfaction of the Engineer-in-Charge before the work is considered as complete.

XI. Post construction inspection and testing: After completion of the work and during maintenance period liability of the contractor, the work shall also be subjected to 'Post construction inspection and testing'. In case the materials or articles incorporated in the work are found to be inferior, though the sample collected for the same might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same at his own cost, failing which the Department may rectify the same at the risk and cost of the contractor or Department may accept the work as sub-standard, and cost be adjusted from the outstanding security deposit, as per the terms and conditions of the contract for the work.

XII. Gold Sunshine Agro Tech shall be the sole deciding authority as to the meaning; interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.

II - LIST OF INDIAN STANDARDS

Following are the Indian Standards, relevant to building works

(All Latest Versions of I.S. code shall be referred)

I. S. CODE NO.	SUBJECT
1. CARRIAGE OF MATERIALS	
4082-1996	Recommendations on stacking & storage of construction materials and components at site.
2. EARTH WORK	
632-1978 (Reaffirmed 2002)	Specification for Gamma-BHC (Lindane) Emulsifiable Concentrate.
1200 (Part-1) 1992	Method of measurement of Earth work.
4081-1986	Safety code for Blasting and related drilling operations.
6313 (Part 2) – 2001	Anti Termite Measures in Buildings –Part-2- Pre-constructional chemical treatment Measures.
6313 (Part 3) – 2001	Anti Termite Measures in Buildings – Part-3- Treatment for existing buildings
6940-1982	Methods of Test of Pesticides and their formulation.
8944-2005	Specification for Chlorpyrifos Emulsifiable Concentrate.
8963-2006	Technical Specification- Chlorpyrifos
3. MORTAR	
196-1966	Atmospheric conditions for testing (Reaffirmed - 1990)
269-2013	Ordinary Portland cement, 33 Grade
383-1970	Coarse and fine aggregates from natural sources for concrete.
455-1989	Portland blast furnace slag cement
650-1991	Standard sand for testing of cement
1344-1981	Specifications for calcined clay pozzolana
1489-1991	Portland pozzolana cement Fly ash based
1542-1992	Sand for Plastering.
1727-1967	Methods of tests for pozzolanic materials
2116-1980	Sand for Masonry mortar
2250-1981	Code of practice for preparation and use of masonry mortar. (Reaffirm- 1990)
2386-1963	Methods of Test for Aggregates for Concrete
2386 Pt.I-1963	Particle size and shape
2386 Pt. II-1963	Estimation of deleterious materials and organic impurities
2386 Pt.III-1963	Specific gravity, density, voids, absorption and bulking

I. S. CODE NO.	SUBJECT
3025-1964	Methods of sampling & test (Physical & Chemical) water used in industry. (Reaffirmed-2003)
3812 (Part-1)-2013	Pulverised Fuel ash: For use as pozzolana in cement, cement mortar and concrete.
3812 (Part-2)-2013	Pulverised Fuel ash: For use as admixture in cement mortar and concrete
4031 (Part-1 to 13) -1996	Methods of physical tests for hydraulic cement
4032-1985.	Method of chemical analysis of hydraulic cement (Reaffirmed - 1990)
8041-1990	Rapid hardening Portland cement
8042-1989	Specifications for white cement
8043-1991	Hydrophobic Portland cement
8112-2013	Specification 43 grade ordinary Portland cement
12269-2013	Specification 53 grade ordinary Portland cement
4. CONCRETE WORK	
383-1970	Coarse and fine aggregate from natural sources for concrete (Reaffirmed - 1990)
456-2000	Code of practice for plain and reinforced concrete
516-1959	Method of test for strength of concrete (Reaffirmed in 2004)
1199-1959	Method of sampling and analysis of concrete
1200 (Part-2)-1987	Methods of measurements of cement concrete work. (Reaffirmed - 1992)
1322-1993	Bitumen felts for water proofing and damp proofing. (Reaffirmed - 1998)
2386 (Part-1 to 8) -1977	Methods of test for aggregate for concrete
2505-1992	Concrete vibrators- Immersion type-General requirements
2506-1985	General requirements of screed type vibrators
2645-2003	Integral water proofing compounds for Cement Mortar and Concrete - Specification
7861-1975 (Part-1)	Hot weather concreting. .(Reaffirmed -1990)
7861-1981 (Part-2)	Cold weather concreting. .(Reaffirmed -1992)
9103-1999	Admixture for concrete.
5. R.C.C. WORK	
432-(Part-1)-1982	Mild steel & medium tensile steel bars and hard drawn steel wire for concrete reinforcement.- Mild steel & medium tensile steel bars
432 (Part-2)-1982	Mild steel & medium tensile steel bars and hard drawn steel wire for concrete reinforcement - Hard drawn steel wire

I. S. CODE NO.	SUBJECT
456-2000	Code of practice for plain and reinforced concrete
457-1957	Code of practice for general const. of plain & reinforced concrete for dams & other massive structure.
516-1959	Methods of test for strength of concrete
1161-1998	Steel tubes for structural purposes
1199-1959	Methods of sampling and analysis of concrete. (Reaffirmed - 1999)
1200 (Part-2)-1974	Method of measurement of cement concrete work
1200 (Part-5)-1982	Method of measurement of form work. (Reaffirmed - 1989)
1343-2012	Pre-stressed Concrete - Code of practice
1566-1982	Hard drawn steel wire fabric for concrete reinforcements (II Rev.) (Reff.1998)
1608-2005	Method of tensile testing of steel products
1785-1983 (Part-I& II)	Specifications for plain hard drawn steel wire for pre-stressed concrete
1786-2008	High Strength Deformed Steel Bars and Wires for Concrete Reinforcement - Specification
1893 (Part-1)-2002	Criteria for Earthquake resistant design of Structures(General provisions and Building)
1893 (Part-4)-2005	Criteria for Earthquake resistant design of Structures (Industrial structures including stack like structures)
2090-1983	Specifications for high tensile steel bars used in pre-stressed Concrete.
2204-1962	Code of practice for construction of reinforced concrete shell roof. (Reaffirmed - 1990)
2210-1988	Criteria for the design of shell structure and folded plates (Reaffirmed - 1998)
2314 -1986	Steel Sheet Piling Sections.
2502-1963	Code of practice for bending and fixing of bars for concrete reinforcement. (Reaffirmed - 1999)
2750-1964	Specifications for steel scaffoldings
2751-1979(Reaf-1992)	Code of practice for welding of mild steel bars used for reinforced concrete construction.
2911-(Part-1)-(Section-1 to 3) 2010	Code of practice for design & Construction of pile foundations
2911(Part-1-Section-4)- 2010	Design & construction of Pile Foundations - Bored precast concrete Piles.
2911(Part-3)-1980	Under reamed pile foundations

I. S. CODE NO.	SUBJECT
2911 (Part-4)-1985	Load test on Piles
3201-1988	Criteria for design and construction of precast concrete trusses. (Reaffirmed -1995)
3370. (Part I to IV)	Code of practice for concrete structures for storage of liquids. (Reaffirmed - 1999)
3414-1968	Code of practice for design and installation of joints in buildings. (Reaffirmed - 1990)
3558-1983(Reaf-91)	Code of practice for use of immersion vibrators for consolidating concrete
3696 (Part 1 & 2)	I-1987: Safety code of scaffolds; II-1991: Safety code of ladders
3935-1966	Code of practice for composite construction. (Reaffirmed – 1998)
4014-1967(Part1 & 2)	COP for steel tubular scaffolding (I: Definition/Material; II: Safety Resolutions) (Reaffirmed 1999)
4326-2013	Earthquake resistant design and construction of Buildings – Code of Practice
4926-2003	Code of practice for Ready Mix Concrete
4990-2011	Plywood for concrete shuttering work - Specifications
5121-1969	Safety code for piling and other deep foundation
9716-1981	Guide for lateral dynamic load test on piles
10262-2009	Guidelines for Concrete Mix Design Proportioning
13311(Part-1)-1992	Non-destructive testing of concrete-Method of test for ultrasound pulse velocity.
13311(Part-2)-1992	Non-destructive testing of concrete-Method of test by rebound hammer.
13920-1993(Reaffirmed 2003)	Code of Practice-Ductile detailing of Reinforced concrete structures subject to seismic forces.
14362-1996	Pile boring equipments-General requirements.
6. EQUIPMENTS	
460-1985(Pt-I,II& III)	Specification for test sieves. (Reaffirmed - 1998)
1791-1985	Specification for batch type concrete mixer. (Reaffirmed – 1990)
2430-1986	Methods for sampling of Aggregates for concrete.
2505-1992	General requirement for concrete vibrators, immersion type
2506-1985	General requirements for screed board concrete vibrators
2514-1963	Specification for concrete vibrating tables. (Reaffirmed - 1991)
2722-1964(Reaf-95)	Specification for portable swing weighs batchers for concrete (single and double bucket type).

I. S. CODE NO.	SUBJECT
2750-1964	Specification for steel scaffolding. (Reaffirmed – 1991)
7. BRICK WORK:	
1077-1992	Common burnt clay building bricks
1200 (Pt.III)-19920	Method of measurements of brick work. (Reaffirmed - 1992)
2116-1980	Sand for masonry mortars. (Reaffirmed - 1998)
2212-1991	Code of practice for brick work
2222-1991	Burnt clay perforated building bricks.
2849-1983	Specification for non- load bearing gypsum partition blocks(solid and hollow types)
3495 (Part 1 to 4)-1992	Method for test for burnt clay building brick
4139-1989	Specification for calcium silicate bricks
5454-1978	Method for sampling of clay building bricks. (Reaffirmed - 1995)
12894-2002	Pulverized fuel ash- lime bricks specification
13757-1993	Specification of burnt clay fly ash bricks
8. STONE WORK:	
1121(Part-1to4)	Methods for determination of compressive, transverse, tensile & shear strengths of natural building stones
1122-1974	Methods for determination of specific gravity and porosity of natural building stones
1123-1975	Methods for identification examination of natural building stones
1124-1974	Methods of test for water absorption of natural building stones
1125-2013	Determination of weathering of natural building stones – Method of Test
1126-2013	Determination of durability of natural building stones – Method of Test
1129-1972	Dressing of natural building stones
1200 (Part-4)-1992	Method of measurement of stone masonry.
1597. (Part-1)-1992	Code of practice for construction of Rubble stone masonry. (Reaffirmed -1996)
1597 (Part-.2)-1992	Code of practice for construction of Ashlar masonry (Reaffirmed - 1996)
1805-1973	Glossary of Terms relating to stone Quarrying and dressing. (Reaffirmed - 1993)
4101 (Part-1)-1967	Stone facing. (Reaffirmed - 1990)

I. S. CODE NO.	SUBJECT
9. MARBLE WORK:	
1122-1974	Methods for determination of specific gravity and porosity of natural building stones
1124-1974	Methods of test for water absorption of natural building stones
1130-1969	Marble (blocks, slabs and tiles)
3316-1974	Structural granite
14223(Part-1)-1995	Polishing building stones-Granite.
10. WOOD WORK:	
204-1991/92	Tower bolts (Part I-1991: ferrous metals; Part II - 1992 : Non ferrous Metals).
205-1992	Non-ferrous metal butt hinges
1734 - 1983	Methods of tests for plywood (IIR) (Ref 1993)
206-2010	Tee and strap hinges - Specification
207-1964	Gate and shutter hooks and eyes. (Reaffirmed - 1996)
208-1996	Door handles - Specification
281-2009	Mild steel sliding door bolts for use with padlocks - Specification
287-1993	Permissible moisture contents of timber used for Different purposes – Recommendations.
303-1989	Plywood for general purpose
362-1991	Parliament hinges
363-1993	Hasps and staples
364-1993	Fanlight catch
401-2001	Preservation of timber Code of practice
419 - 1967	Putty for use on window frame (I Rv.) (and out 3)
451-1999	Technical supply condition for wood screws
452-1973	Door springs, rat-tail type(II Rev.) (Reaffirmed 1990)
453-1993	Double acting spring hinges. (Reaffirmed – 1999)
707-2011	Glossary of term applicable to timber technology and utilization.
710-2010	Specifications for marine ply.
723-1972	Steel counter sunk head wire nails. (Reaffirmed - 1996)
729-1979	Drawer locks, cupboard locks, and box locks (III Rev.) (Reaffirmed 1992)
848-2006	Specification for Synthetic resin adhesive for plywood (phenolic and aminoplastic)
851-1978	Synthetic resin adhesive for construction work (Non-structural) in wood (I-Rev.) (Amt) (Reaffirmed 1990)
852-1994	Specifications for animal glue for general wood working purposes.

I. S. CODE NO.	SUBJECT
875 (Part-1) - 1987	Dead loads – Unit weight of building materials & stored materials
883-1994	Design of structural timber in Building.
1003(Part-1I)-2003	Timber panelled and glazed shutters (Door shutters)
1003 (Part-2)-1994	Timber panelled and glazed shutters(windows and ventilator shutters)
1019-1974	Rim latches. (Reaffirmed - 1991)
1141-1993	Code of practice for seasoning of timber (II Rev.)
1200	Method of measurement of Building and Civil Engineering works
1200 (Part-14)-1984	Glazing. (Reaffirmed - 1990)
1200 (Part-21)-1973	Wood work and joinery. (Reaffirmed - 1992)
1328-1996	Veneered decorative plywood
1341-1992	Steel Butt hinges (VI Rev.)
1378-1987	Oxidized copper finishes. (Reaffirmed - 1998)
1568-1970	Wire cloth for general purposes. (Reaffirmed - 1998)
1658-2006	Fiber hard board - Specifications
1659-2004	Block boards
1708-1986	Method of testing of clear specimen of timber (II Rev) (Q.1) (Reaffirmed 1990)
1823-1980	Floor door stoppers. (Reaffirmed - 1992)
1837 – 1966	Fanlight pivots (I Rev.) (Reaffirmed 1990)
1868-1996	Anodic coating on Aluminium & its alloy (II Rev.) (Reaffirmed 1991)
2046-1995	Decorative thermosetting synthetic resins bonded laminated sheet.
2095 (Part 1) – 2011	Gypsum plaster board – Part 1 – Plain Gypsum Plaster Board.
2095 (Part 2) – 2001	Gypsum plaster board – Part 2 – Coated/ Laminated Gypsum Plaster Board.
2096-1992	Specification for A.C. flat sheet.
2191(Part1)-1983	Wooden flush door shutter (cellular and hollow core type)- Plywood face panels
2191 (Part2)-1983	Particle board face panels and hard board face panels. (Reaffirmed-1991)
2202-(Part1)1999	Wooden flush door shutters (solid core type)- Plywood face panels
2202 (Part2)-1983	Particle board face panels for wooden flush door shutters. (Reaffirmed - 1991)
2209(Part1)-1976	Mortise locks (vertical type) (Reaffirmed 1992)
2380-1981	Method of test for wood particle board and boards from lignocellulosic materials (Reaf.1993)

I. S. CODE NO.	SUBJECT
2547-1976	Specification for gypsum plaster
2681-1993	Non ferrous metal sliding door bolts (aldrop) for use with pad locks
2753-1991	Method for estimation of preservatives in treated timber and its treating solutions.
2835-1987	Flat transparent sheet glass (3rd Revision). (Reaffirmed - 1992)
3087- 2005	Particle boards of wood and other lignocellulosic materials (medium density) for general purposes - Specification
3097- 2006	Veneered particle boards - Specification
3400 (Part I)-2012	Method of test for vulcanized rubbers Part 1: Tensile Stress – Strain Properties
3400-(Part2)-2003	-Hardness
3400-(Part4)-1987	-Accelerated aging
3400 (Part9)-2003	-Relative density and density.
3564-1995	Door closers (Hydraulically regulated)
3618-1966	Phosphate treatment of iron and steel for protection against corrosion. (Reaffirmed - 1991)
3818-1992	Continuous (Piano) hinges
3828 – 1968	Ventilator chains (Reaffirmed 1990)
3847-1992	Mortise Night Latches
4020-1998 (1 to 16)	Methods of tests for wooden flush Doors .
4021-1995	Timber door, window and ventilator frames
4835 - 1979	Polyvinyl acetate dispersion base adhesive for wood (1990)
4948-2002	Welded steel wire fabric for general use. (Reaffirmed - 1992)
4992-1975	Door Handles for mortise locks (vertical type). (Reaffirmed - 1990)
5187-1972	Flush bolts (1990)
5509-2000	Specification for Fire Retardant Plywood
5523-1983	Method of testing anodic coating on aluminium & its alloys. (Reaffirmed -1991)
5930-1970	Mortise latch (vertical types) (1991)
6318-1971	Plastic window stays & fasteners
6607-1972	Rebated mortise locks (vertical type)
6760-1972	Slotted countersunk head wood screws. (Reaffirmed - 1988)
7196-1974	Hold fasts (1992)
7197-1974	Double action floor springs (without oil check) for heavy doors
7534-1985	Sliding locking bolt for use with padlocks. (Reaffirmed – 1991)

I. S. CODE NO.	SUBJECT
7638-1999	Wood/lignocellulosic based panel products-Method for sampling
8756 - 1978	Mortise ball catches for use in wooden almirah (1992)
11215-1991	Moisture content of timber and timber products-Method of determination.
12406 - 2003	Medium density fibre board for general purpose - Specification
12817-2013	Stainless steel Butt hinges
12823-1990	Specification for wood products-Pre-laminated particle boards
14856-2000	Glass fibre reinforced plastic (GRP) panel type door shutters for internal use - Specifications
14900-2000	Specification for transparent float glass.
11. STEEL WORK:	
63-2006	Whiting for paints
198-1978	Varnish, gold size. (Reaffirmed - 1991)
228--1987	Methods of chemical analysis of Structural steel
277-2003	Specification for galvanised steel sheets (plain and corrugated)
278-2009	Galvanised steel barbed wire for fencing - Specification
800-2007	General Construction in Steel - Code of practice
806-1968	Code of practice for use of steel tube in general building construction
813-1986	Scheme of symbols for welding. (Reaffirmed – 2003).
814-2004	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
817-1966	Code of practice for training and testing of metal arc welders. (Reaffirmed – 2003)
818-1968 (Reaf-03)	COP for safety & healthy requirements in electric & gas welding & cutting operation.
822-1970	Code of practice for inspection of welds..
1038-1983	Steel doors, windows and ventilators
1081-1960(Reaf-91)	COP for fixing & glazing of metal (steel & aluminium) doors, windows & ventilators
1148-2009	Steel rivet bars (Medium and High Strength) for structural purposes
1161-1998	Steel tubes for structural purposes
1182-1983(Reaf-00)	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
1200 (Part8)-1993	Method of measurements of steel work and iron works
1363-2002 (Part 1 to 3)	Hexagon head bolts, screws and nuts of product grade C
1599-2012	Metallic Materials – Bend Test
1608-2005	Mechanical testing of materials - tensile testing

I. S. CODE NO.	SUBJECT
1821-1987	Dimensions for clearance holes for metric bolts. (Reaffirmed - 2003)
1852-1985	Rolling and cutting tolerance for hot rolled steel products. (Reaffirmed - 1991)
2062-2011	Hot rolled medium and high tensile structural steel
4351-2003	Steel door frames. (Reaffirmed – 1991)
4736-1986	Hot-dip zinc coatings on steel tubes. (Reaffirmed – 2001)
4923-1997	Hollow steel sections for structural use-specification
6248-1979	Metal rolling shutters and rolling grills.
6911-1992(Reaf-1998)	Stainless Steel plates, Sheet and Strip- Specification.
7452-1990	Hot rolled steel sections for doors, windows & ventilators.
12. FLOORING:	
210-2009	Grey iron casting
653-1992	Sheet linoleum
809-1992	Rubber flooring materials for general purpose
1122-1974	Methods for determination of specific gravity (*and porosity of natural building stones)
1124-1974	Method of test for water absorption of natural building stones
1130-1969	Marble (blocks, slabs and tiles). (Reaffirmed – 1993)
1197-1970	Code of practice for laying of rubber floors. (Reaffirmed – 1990)
1198-1982	Code of practice for laying and maintenance of linoleum floors
1200 (Part11)-1977	Method of measurements of paving and floor finishes.
1237-2012	Cement concrete flooring tiles - Specifications
1443-1972	Code of practice for laying and finishing of cement concrete flooring tiles
1661-1972	Code of practice for application of cement and cement lime plaster finishes
2114-1984	Code of practice for laying in situ terrazzo floor finish
2571-1970	Code of practice for laying in situ cement concrete flooring
3462-1986	Flexible P.V.C. Flooring. (Reaffirmed – 1991)
3670	Code of practice for construction of timber floor
4457	Acid and/or alkali resistant tiles.
4631-1986	Code of practice for laying of resin floor toppings (Reaffirmed – 2001)
5318-1969	Code of practice for laying of flexible P.V.C. sheet & tiles flooring
5389-1969	Code of practice for laying of hardwood parquet and wood block floors. (Reaffirmed – 1998)
9197-1979	Specifications for epoxy resin, hardeners and epoxy resin compositions for floor topping (Reaffirmed – 2001)

I. S. CODE NO.	SUBJECT
13630 (Part1to15) -2006	Methods of tests for ceramic tiles.
13712-2006	Specification for ceramic tiles; definition, classification, characteristic and marking.
15622-2006	Specification for pressed ceramic tile
15685-2006	Precast Concrete Blocks for paving - Specification
13. ROOFING	
73-2013	Paving Bitumen
277-2003	Galvanized steel sheets (plain and corrugated)
458-2003	Concrete pipes (with and without reinforcement)
459-1992	Unreinforced corrugated and semi-corrugated asbestos cement sheets
651-2007	Glazed stone ware pipes and fittings
702-1988	Industrial Bitumen
1199-1959	Method of Sampling & Analysis of concrete. (Reaffirmed - 1991)
1200 (Part9)-1973	Method of measurements of roof covering (including cladding)
1200 (Part10)-1973	Method of measurements of ceiling and lining
1322-1993	Bitumen felts for water proofing and damp-proofing. (Reaffirmed - 1988)
1346-1991	Code of practice for waterproofing of roof with bitumen felts
1609-1991	Code of practice for laying damp proof treatment using bitumen felts
1626-1994(Part 1-3)	Asbestos cement building pipes, gutters and fittings (Spigot and socket types)
1834-1984	Specification for hot applied sealing compounds for joints in concrete. (Reaffirmed - 1990)
1838-(Part 1 & 2)-1983	Preformed filler for expansion joints in concrete- non-extruding and resilient type Bitumen impregnated fiber). (Reaffirmed - 1990)
2115-1980	Code of practice for flat roof finish: mud phuska. (Reaffirmed - 1998)
2633-1986	Method of testing uniformity of coating on zinc coated articles. (Reaffirmed – 2001)
3007-(Part1)-1999	Code of practice for laying of corrugated asbestos cement sheets. (Reaffirmed – 1991)
3007-(Part2)-1999	Code of practice for laying of semi corrugated asbestos cement sheet. (Reaffirmed - 1991)
3348-1965	Fibre insulation boards. (Reaffirmed - 1990)
3384	Specification for bitumen primer for water proofing and damp proofing.
3607-1979	Magnesite for chemical Industry. (Reaffirmed – 2003)

I. S. CODE NO.	SUBJECT
4671	Expanded polystyrene for thermal insulation purposes.
7193-2013	Glass fibre base Bitumen felts
8183-1993	Bonded mineral wool. (Reaffirmed 2004)
14862	Fibre cements flat sheets- specifications.
14871	Specifications for products in fibre reinforced cement-Long corrugated or Asymmetrical section sheets and fittings for roofing and cladding.
14. FINISHING	
75-1973	Linseed oil, raw and refined. (Reaffirmed – 2003)
77-1976	Linseed oil, boiled, for paints. (Reaffirmed - 1999)
104-1979	Specification for ready mixed paint, brushing, zinc chrome, priming. (Reaffirmed - 1999)
109-1968	Specification for ready mixed paint, brushing priming plaster to Indian Standard colour, white and off white.
133-2004	Enamel, interior (a) under coating (b) finishing colour as required
137-1965	Ready mixed paint, brushing, matt or egg-shell flat, finishing, interior, to Indian Standard Colour, as required. (Reaffirmed – 1999)
158-1981	Ready mixed paint, brushing, bituminous, black lead free acid alkali, water and heat resisting for general purposes. (Reaffirmed – 1999)
168-1993	Ready mixed paint, air drying for general purpose.(Reaffirmed 2002)
217-1988	Cut back bitumen (reaffirmed 1999)
218-1983	Creosote and anthracene oil for use as wood preservatives (Reaffirmed 1998)
337-1975	Varnish, finishing interior. (Reaffirmed – 2001)
341-1973	Black Japan, types A, B, and C (Reaffirmed 2002)
347-1975	Varnish, shellac for general purpose. (Reaffirmed – 2001)
348-1968	French polish. (Reaffirmed – 2001)
419-1967	Putty for use of window frames. (Reaffirmed – 2001)
427-2013	Distemper, dry, colour as required.
428-2013	Washable distemper - Specification
524-1983	Varnish, finishing, exterior, synthetic air drying. (Reaffirmed – 2000)
525-1968	Varnish, finishing, exterior and general purposes. (Reaffirmed –2001)
533-2007	Gum spirit of turpentine (oil of turpentine)
712-1984	Specification for building limes. (Reaffirmed - 1995)
1200 (Part12)-1976	Method of measurements of plastering and pointing
1200 (Part13)-1994	Method of measurements of white washing, colour washing, distempering and other finishes
1200 (Partt.15)-1987	Methods of measurements of painting, polishing & varnishing.

I. S. CODE NO.	SUBJECT
2095 (Part1-3)	Gypsum plaster boards
2096-1992	Asbestos cement flat sheets.
2339-2013	Aluminium paint for general purposes – Specification
2547-1976 (Part2)	Gypsum building plaster-premixed light weight plasters.
2932-2003	Enamel synthetic, exterior (a) Under coating (b) Finishing.
2933-1975	Enamel, Exterior (a) Under coating (b) Finishing
5410-2002	Cement paint - Specification
6278-1971	Code of practice for white washing & colour washing. (Reaffirmed - 1991)
13607 – 1992	Ready Mixed Paint, Finishing, General Purposes, Synthetic (Reaffirmed 2002)
15489-2013	Paint, Plastic Emulsion - Specification
15. ALUMINIUM:	
733-1983	Wrought Aluminium and Aluminium alloys, bars, rods and sections(For General Engineering purpose)-Specification.
737-2008	Wrought Aluminium and Aluminium alloys sheet and strip for General Engineering purpose)-Specification.
1285-2002	Wrought Aluminium and Aluminium alloys, Extruded round tube and Hollow section and sections (For General Engineering purposes)-Specification.
1868-1996	Anodic coating on Aluminium and its alloys- Specification.
1948-1961	Specification for Aluminium Doors, windows and ventilators.
2553 – 1990 (Part 1)	Safety Glass- General Purpose **(For toughened and laminated glass)**
3908-1986	Specification for Aluminium equal leg angles.
3909-1986	Specification for Aluminium unequal leg angles.
5523-1983	Method of testing anodic coating on aluminium and its alloy.
6477-1983	Dimensions of extruded hollow section and tolerances.
14900-2000	Transparent Float glass-Specification.
16. WATER PROOFING:	
1322-1993	Specifications for bitumen felts for water proofing and damp proofing
2645-2003	Specifications for Integral cement water proofing compounds.
3370-(Part1)2009	Code of practice for concrete structures for the storage of liquid-General requirements
3370-(Part2)2009	Code of practice for concrete structures for the storage of liquid-Reinforced concrete structures.
3384-1986	Specifications for bitumen primer for water proofing and damp

I. S. CODE NO.	SUBJECT
	proofing.
7193-2013	Glass fibre base bitumen felts.
12200-2001	Provision of water stops at transfers construction joints in masonry and concrete dams-code of practice.
12432(Part3)-2002	Application for spray applied insulation- Code of practice: Polyurethane/ polyisocyarurate.
17. DEMOLITION AND DISMANTLING:	
1200(Part18)-1974	Method of measurements of building- demolition and dismantling.
4130-1991	Demolition of buildings - Code of Safety
18. ROAD WORKS:	
73-2013	Paving Bitumen
164-1981	Ready mixed paint for road marking
217-1988	Cut Back bitumen
334-2002	Glossary of terms relating to bitumen and tar.
702-1988	Specification for industrial bitumen.
1195-2002	Specification for l bitumen mastic for flooring
1834-1984	Specification for hot applied sealing compound for joints in concrete.
2720(Part5)-1985	Method of test for soil: determination of liquid limit and plastic limit.
2720(Part7)-1980	Method of test for soil: determination of water content - dry density relation using light compaction.
2720(Part27)-1974	Method of test for soil: determination of dry density of soils in place, by sand replacement method.
5640-1970	Method of test for determining aggregate impact value of soft coarse aggregates.
IRC 10	Recommended practice for borrow pits for road embankments constructed by manual operation.
IRC 29	Specification for bituminous concrete for road pavements
IRC 36	Recommended practice for construction of earth embankments for road works.
IRC 60	Tentative guidelines for the use of lime fly ash concrete as pavement base of sub base.
IRC 88	Recommended practice for lime fly ash stabilized soil base/sub base in pavement construction.
IRC 107	Tentative Specification for bitumen mastic wearing courses.

I. S. CODE NO.	SUBJECT
19. SAFETY CODES	
818-1968 (Reaffirm-2003)	Safety and healthy requirements in Electric and gas welding and cutting operations.
3696 (Part-I)-1987	Safety code for scaffolds
3696 (Part-II)-1991	Safety code for ladders
3764-1992	Safety code for Excavation works
4081-1986	Safety code for blasting and related drilling operation
4130-1991	Safety code for Demolition of Building
5916-1970	Safety code for construction involving use of hot bituminous materials
6922-1973(Reaffirm-2003)	Criteria for safety & Design of structures subject to underground blasts.
7293-1974	Safety code for working with construction machinery.

GENERAL CONTENTS

1.0 PREAMBLE

These Specifications cover the items of work in structural and non-structural parts of the works coming under Preview of this document. All work shall be carried out in conformation with this. In general, provisions of Indian Standards, Indian Roads Congress Codes and other national standards have been followed. These specifications are not intended to cover the minute details. All codes and standards referred to in these specifications shall be the latest thereof.

These specifications shall be read in conjunction with the Particular Specifications for various items of work. The Contractor shall carefully acquaint himself with the general specifications, coordinate the same with any other specifications forming a part of the Contract Document and determine his contractual obligations for the execution of various items of work in accordance with good engineering practices.

2.0 REFERENCE TO THE STANDARD CODES OF PRACTICE

2.1 All standards, tentative specifications, specifications, code of practice referred to shall be the latest editions including all applicable official amendments and revisions. The contractor shall make available at site all relevant Indian Standard Codes of Practice as applicable.

2.2 In case of discrepancy between standards, codes of practice, tentative specifications, and specifications referred to, the specifications of Indian Standard Codes of practice shall govern.

3.0 DIMENSIONS

3.1 Written dimensions on drawings shall supersede measurement by scale and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.

3.2 The dimensions where stated do not allow for waste, laps, joints, etc. but the Contractor shall provide at his own cost sufficient labor and materials to cover such waste, laps, joints, etc. and the rate quoted is inclusive of such provision and no separate payment will be made for the same.

3.3 The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

4.0 MATERIALS

4.1 QUALITY

All materials used in the Works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian Standards.

4.2 SAMPLING AND TESTING

All materials used in the Works shall be subjected to inspection and tests in addition to test certificates. Samples of all materials proposed to be employed in permanent Works shall be submitted to the Engineer for approval before they are brought to the site.

Samples provided to the Engineer for their retention are to be labeled in boxes suitable for storage. Materials or workmanship not corresponding in character and quality with approved samples will be rejected by the Engineer.

Samples required for approval and testing must be supplied sufficiently in advance to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected further samples may be required. Delay to the Works arising from the late submission of samples will not be acceptable as a reason for delay in completion of the Works.

Materials shall be tested before leaving the manufacturer's premises, quarry or source, wherever possible. Materials shall also be tested on the site and they may be rejected if not found suitable or in accordance with the specifications, notwithstanding the results of the tests at the manufacturer's Works or elsewhere or test certificates or any approval given earlier.

The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer. No extra payment shall be made on this account.

4.3 DISPATCH OF MATERIALS

Materials shall not be dispatched from the manufacturer's Works to the site without written authority from the Engineer.

4.4 TEST CERTIFICATES

All manufacturer's certificates of test, proof sheets, etc. showing that the materials have been tested in accordance with the requirement of this specifications and of the appropriate Indian Standard are to be supplied free of charge on request to the Engineer.

4.5 REJECTION

Any materials that have not been found to conform to the specifications will be rejected forthwith and shall be removed from the site by the Contractor at his own cost.

The Engineer shall have power to cause the Contractors to purchase and use such materials from any particular source, as may in his opinion be necessary for the proper execution of the work.

4.6 STORING OF MATERIALS AT SITE

All materials used in the Works shall be stored on racks, supports, in bins, under cover etc. as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer. The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage of construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials". This shall include the safe custody of all materials until they are required on the works and till the completion of the works. The same shall be applicable for the materials supplied by the Employer or materials supplied by any specialized firms.

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place where material is stored by the Contractor be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer.

4.7 WATER

4.7.1 Water for construction: Clean fresh water only shall be used for the Works. The water shall be free from any deleterious matter in solution or in suspension. The quality of water shall conform to IS 465.

4.7.2 Storage of water: The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

5.0 WORKMANSHIP

5.1 All Works shall be true to level, plumb and square and the corners, edges and corners in

all cases shall be unbroken and neat.

5.2 Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified, or removed and replaced with work of the required workmanship at no extra cost.

6.0 INCLUSIVE DOCUMENTS

The provision of Special Conditions of Contract, General Conditions of Contract, those specified on the tender as well as execution drawings and notes or other specifications issued in writing by the Engineer-In-Charge shall from part of these specifications.

7.0 MEASUREMENT AND PAYMENTS

The methods of measurement and payment shall be as described under various items and in the bill of quantity. Where specific definitions are not given, the methods described in IS code will be followed. Should there be any detail of construction or materials which has not been referred to in specification or in the bill of quantities and drawings but the necessity for which may be implied or inferred wherefrom, or which are usual or essential to the completion of the work in the trades, the same shall be deemed to be included in the rates and prices quoted by the contractor in the bill of quantities.

8.0 UNACCEPTABLE WORKS

All defective works are liable to be demolished, rebuilt and defective materials replaced by the contractor at his own cost. In the event of such works being accepted by carrying out repairs etc. as specified by the engineer, the cost of repairs will be borne by the contractor.

In the event of the work being accepted by giving 'Design Concession', arising out of but not limited to under-sizing, under-strength, shift in location and alignment, etc. and accepting design stresses in members which are higher than those provided for in the original design or by accepting materials not fully meeting the specifications etc. the contractor will be paid for the works actually carried out by him at the suitable reduced rate of the tendered rates for the portion of the work thus accepted.

PILE FOUNDATION

CONTENTS

1.0 SCOPE

This standard covers the design and construction of load bearing concrete bored cast-insitu piles of diameter less than or equal to 2 500 mm which transmit the load of the structure to the soil by resistance developed either at the tip by end-bearing or along the surface of the shaft by friction or by both. This also covers piles having non-circular cross-sections.

This standard does not cover the use of bored cast-in-situ piles for any other purpose, for example, temporary or permanent retaining -structures, etc. The bored cast-in-situ piles having bulb(s) known as under-reamed piles are covered in IS: 2911 (Part III)-1980*.

2.0 MATERIAL & STRESSES

2.1 CEMENT: The cement used shall conform to the requirements of IS : 269-1976f, IS : 455-1976, IS : 8841-1978 II and IS : 6903-1973 as the case may be.

2.2 REINFORCEMENT: Reinforcement steel shall conform to IS : 432 (Part I)-1966** or IS : 1139-1966 or IS : 786-1966 or IS : 226-19755. The stresses allowed in steel should conform to IS : 456-1978

2.3 CONCRETE: Materials and methods of manufacture for cement concrete shall in general be in accordance with the method of concreting under the conditions of pile installation. Consistency of concrete for cast-in-situ piles shall be suitable to the method of installation of piles. Concrete shall be so designed or chosen as to have homogeneous mix having a flowable character consistent with the method of concreting under the given conditions of pile installation. In achieving these results, minor deviations in the mix proportions used in structural concrete may be necessary.

For pile of smaller diameter and depth of up to 10 m, the minimum cement content should be 350 kg/m3 of concrete. For piles of large diameter and/or deeper piles, the minimum cement content should be 400 kg/m3 of concrete. For design purposes, the strength of concrete mix using the quantities of cement mentioned above, may be taken equivalent to M 15 and M 20 respectively for concrete with cement content of 350 kg/ma and 400 kg/ma. Where concrete of higher strength is needed, richer concrete mix with greater cement content may be designed. In case of piles subsequently exposed to free water or in case of piles where concreting is done under water or drilling mud using methods other than the tremie, 10 percent extra cement over that required for the design grade of concrete at the specified slump shall be used subject to minimum quantities of cement specified above.

Clean water, free from acids and other impurities, shall be used in the manufacture of concrete. The average compressive stress under working load should not exceed 25 percent of the specified works cube strength at 28 days calculated on the total cross sectional area of the pile. When concreting is done using a tremie, allowable stress in concrete may be 33.33 percent of the specified works cube strength at 28 days and aggregates more than 20 mm shall not be used.

3.0 WORKMANSHIP/PILE DRIVING

3.1 CONTROL OF PILE INSTALLATION

Bored cast-in-situ piles may be adopted by suitable choice of installation techniques; covering the manner of. Soil stabilization that is use of casing and/or use of drilling mud; manner of concreting that is direct pouring and placing or by use of termite and choice of boring tools in order to permit a satisfactory installation of a pile at a given site. Sufficient detailed information about the subsoil conditions is essential to predetermine the details of the installation technique.

3.1.1 CONTROL OF ALIGNMENT - Piles shall be installed as accurately as possible as per the designs and drawings either vertically or to the specified batter. Greater care should be exercised in respect of installation of single pile or piles m two pile groups. As a guide, for vertical piles a deviation of 1.5 percent and for raker piles a deviation of 4 percent should not normally be exceeded although in special cases a closer tolerance may be necessary. Piles should not deviate more than 75 mm or D/10 whichever is more in case of piles having diameter more than 600 mm from their designed positions at the working level of the piling rig. In the case of a single pile in a column positional tolerance should not be more than 50 mm (100 mm in case of piles having diameter more than 600 mm). Greater tolerance may be prescribed for piles driven over water and for raking piles. For piles to be cut-off at a substantial depth, the design should provide for the worst combination of the above tolerances in position and inclination. In case of piles deviating beyond these limits and to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap of pile ties, the piles should be replaced or supplemented by one or more additional piles. In case of piles, with non-circular cross section 'D' should be taken as the dimensions of pile, along which the deviation is computed. In such cases the permissible deviation in each direction should be different depending upon the dimension of the pile along that direction.

Any deviation from the designed location, alignment or load capacity of any pile shall be noted and adequate measures taken well before the concreting of the pile cap and plinth beam.
A minimum length of one metre of temporary casing shall be inserted in each bored pile unless otherwise specifically desired. Additional length of temporary casing may be used depending on the condition of the strata, ground water level, etc. Drilling mud of suitable consistency may, also be used instead of temporary casings for stabilizing sides of the holes.

In case, a bored pile is stabilized by drilling mud or by maintaining water heads within the hole, the bottom of the hole shall be handed very carefully before concreting work is taken up. The cleaning of the hole may be ensured by careful operation of boring tool and/or flushing of the drilling mud through the bottom of the hole. Flushing of bore holes before concreting with fresh drilling fluid/mud is preferred.

In case a hole is bored by use of drilling mud, the specific gravity of the mud suspension near about the bottom of the hole shall, whenever practicable, be determined by suitable slurry sampler in a first few piles and at suitable interval of piles and recorded. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concretin operations in order to keep the hole stabilized as well as to avoid concrete getting mixed up with the thicker suspension of the mud.

The concreting operations should not be taken up when the specific gravity of bottom slurry is more than l-2. Concreting shall be done by tremie method in all such cases. The slurry should be maintained at 1.5 m above the ground water level if casing is not used.

Concreting under water may be done either with the use of tremie method or by the use of specially designed underwater placer to permit deposition of concrete in successive layers, without permitting the concrete within the placer to fall through free water.

3.1.2 TREMIE METHOD-In addition to the normal precautions to be taken in tremie concreting, the following requirements are particularly applicable to the use of tremie concrete in pipes.

a) The concrete should be coherent, rich in cement (not less than 370 kg/m3) and of slump not less than 150 mm.
b) When concreting is carried out under water a temporary casing should be installed to the full depth of the bore hole or 2 m into non-collapsible stratum, so that fragments of ground cannot drop from the sides of the hole into the concrete as it is placed. The temporary casing may not be required except near the top when concreting under drilling mud.
c) The hopper and tremie should be a closed system embedded in the placed concrete, through which water cannot pass.
d) The tremie should be large enough with due regard to the size of the aggregate. For 20 mm aggregate the tremie pile should be of diameter not less than 200 mm, aggregates more than 20 mm shall not be used.
e) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it or with a steel plate of adequate charge to prevent mixing of concrete and water. However, the plug should not be left in the concrete as a lump.
f) The tremie pipe should always penetrate well into the concrete with an adequate margin if safety against accidental withdrawal of the pipe is surged to discharge the concrete.
g) The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile, to prevent the laitance from being entrapped within the pile.
h) All tremie tubes should be scrupulously cleaned after use.

Normally concreting of the piles should be uninterrupted. In the exceptional case of interruption of concreting; but which can be resumed within 1 or 2 hours, the tremie shall not be taken out of the concrete. Instead it shall be raised and lowered slowly, from time to time

to prevent the concrete around the tremie from setting. Concreting should be resumed by introducing a little richer concrete with a slump of about 200 mm for easy displacement' of the partly set concrete. If the concreting cannot be resumed before final set up concrete already placed, the pile. So cast may be rejected or accepted with modifications.

In case of withdrawal of tremie out of the concrete, either accidentally or to remove a choke in the tremie, the tremie may be re-introduced in the following manner to prevent impregnation of laitance or scum lying on the top of the concrete already deposited in the bore.

The tremie shall be gently lowered on to the old concrete with very little penetration initially. A vermiculite plug should be introduced in the tremie. Fresh concrete of slump between 150 mm and 175 mm should be filled in the tremie which will push the plug forward and will emerge out of the tremie displacing the laitance/scum. The tremie will be pushed further in steps making fresh concrete sweep away laitance/scum in its way. When tremie is burried by about 69 to 103 cm, concreting may be resumed.

During installation of bored cast-in-situ piles, the convenience of installation may be taken into account while determining the sequence of pilling in a group.

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

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

3.1.3 DEFECTIVE PILE: In case, defective piles are formed, they shall be removed or left in place whichever is convenient without affecting performance of the adjacent piles or the cap as a whole. Additional piles shall be provided to replace them as directed.

Any deviation from the designed location alignment or load capacity of any pile shall be noted and adequate measures taken well before the concreting of the pile cap and plinth beam if the deviations are beyond the permissible limit.

During chipping of the pile top manual chipping may be permitted after three days of pile casting; pneumatic tools for chipping shall not be used before seven days after pile casting.

After concreting the actual quantity of concrete shall be compared with the average obtained from observations actually made in the case of a few piles initially cast. If the actual quantity is found to be considerably less, special investigations shall be conducted and appropriate measures taken.

3.1.4 RECORDING OF DATA: A competent inspector shall be maintained at site to record necessary information during installation of piles and the data to be recorded shall include:

a) Sequence of installation of piles in a group;

b) Dimensions of the pile, including the reinforcement details and mark of the pile;

c) Depth bored;

d) Time taken for concreting;

e) Cut off level/working level;

f) When drilling mud is used, the specific gravity of the fresh supply and contaminated mud in the hole before concreting is taken up, shall be recorded in case of first ten piles, and subsequently at an approximate interval of 10 piles or earlier; and Any other important observation.

3.1.5 STRIPPING PILE HEADS

The concrete should be stripped to a level such that the remaining concrete of a pile will project minimum 50 mm into the pile cap. The effect of this projection on the position of any reinforcement in the pile cap should be considered in design. The pile reinforcement should be left with adequate projecting length above the cut off level for proper embedment into the pile cap. Exposing such length should be done carefully to avoid shattering or otherwise damaging the rest of the pile. Any cracked or defective concrete should be cut away and made good with new concrete properly bonded to the old.

3.1.6 DRIVING

There is some evidence to suggest that a larger ratio of hammer weight to pile weight is required to avoid damaging the pile. Driving of prestressed concrete piles should follow the recommendations for reinforced concrete piles as in 7.5. Although the effect of prestressing is to reduce tension cracks induced by stress waves, such cracking may still occur, particularly when driving is ‘ light ‘, or if too light a hammer is used. A careful check for tension cracks should be made during the driving of the first pile and, if these occur, the hammer drop should be reduced. If the cracks persist or recur when the full drop has to be used, then a heavier hammer should be substituted.

3.1.7 BONDING OF HEAD OF PILE INTO PILE CAP

The concrete of the pile may be stripped to expose the prestressing wires. The concrete should be stripped to such a level that the remaining concrete projects 50 mm to 7.5 mm into the pile cap. Where tension has to be developed between the cap and pile, the exposed prestressing wires should extend at least 600 mm into the cap. An alternative method is to incorporate mild steel reinforcement in the upper part of the pile. After stripping the concrete this reinforcement should be bonded into the cap.

3.1.8 FLUSHING

The central duct/hole shall be connected to a suitable pump and water drilling fluid allowed to flow through the bottom of the pile removing loose material.

3.1.9 GROUTING

Sand and cement grout mixed with water in a high speed colloidal mixer is to be fed into the pile with a grout pump of suitable capacity connected to the central duct through a manifold. A grout of sand and cement with additives as necessary, of strength not less than 1: 2 cement and sand suitable for pumping into the annulus, may also be used. The temporary casing here used shall be removed in stages with the rise of the level of grout. After final removal of the temporary casing, the grout level shall be brought up to the top by pouring in additional grout as required.

3.2 CASTING AND CURING

The piles should be cast in a continuous operation from end to end of each pile. The concrete should be thoroughly compacted against the forms and around the reinforcement by means of immersion and/or shutter vibrators. The faces of the pile including those exposed at the top of pile should be dense as far as possible. Immediately on completion of the casting the top surface should be finished level without excessive trowel ling. Care should be taken to ensure that vibration from adjoining work does not & the previously placed concrete for piles during the setting period.

Where Portland cement concrete with ordinary or rapid-hardening cement is used, piles shall be kept continuously wet for at least 7 days, but longer curing shall be applied when hard driving is expected and in all cases where it is practicable to do so. When piles are stacked between the period of wet curing and driving, they shall be protected from rapid drying by sheltering them from the wind and direct sunlight by covering the stacks.

Though from consideration of speed and economy precast concrete piles will have to be driven with the least possible delay after casting, it shall be kept in mind that a thorough curing and hardening is necessary before the piles are driven and proper schedule to take care of this shall be decided for the operations of casting, stacking and driving. The most important factors affecting the time of curing are the method of curing, weather during hardening, probable

hardness of driving and the method of lifting and pitching.

3.3 STORING AND HANDLING

Piles shall be stored on firm ground free from liability to unequal subsidence or settlement under the weight of the stack of piles. The piles shall be placed on timber supports which are truly level and spaced so as to avoid undue bending in the piles. The supports shall be verticality one above the other. Spaces shall be left round the piles to enable them to be lifted without difficulty. The order of stacking shall be such that the older pile can be withdrawn for driving without disturbing the newer piles. Separate stacks shall be provided for different lengths of piles. Wherever curing is needed during storage, arrangements shall be made to enable the piles to be watered if weather conditions so require. For &tailed precautions with regard to curing operations reference may be made to IS : 456-1978.

Care shall be taken at all stages of transporting, lifting and handling of the piles that they are not damaged or cracked. During transportation the piles shall be supported at the appropriate lifting holes provided for the purpose. If the piles are put down temporarily after being lifted they shall be placed on trestles or blocks located at the lifting points.

3.4 SEQUENCE OF PILING

In a pile group the sequence of installation of piles shall normally be from the centre to the periphery of the group or from one side to the other.

Consideration should be given to the possibility of doing harm to a pile recently formed by driving the tube nearby before the concrete has sufficiently set. The danger of doing harm is greater in compact soils than in loose soils.

Driving piles in loose sand tends to compact the sand which, in turn, increases the skin friction. Therefore, the order of installing of such a pile in a group should avoid creating a compacting block of ground into which further piles cannot be driven.

In case where stiff clay or compact sand layers have to be penetrated, similar precautions need be taken. This may be overcome by driving the piles from the centre outwards or by beginning at a selected edge or working across the group. However, in the case of very soft soils, the driving may have to proceed from outside to inside so that the soil is restrained from flowing out during operations.

3.5 CONTROL OF PILE DRIVING

The hammer blow generates a stress wave which traverses the length of the pile, and failure, whether by compression or tension, may occur anywhere along the pile.

Failure due to excessive compressive stress most commonly occurs at the head. Head stresses,

which in general are independent of ground conditions, depend upon the weight of the hammer, its drop and the stiffness of head cushion.

The maximum set for a given stress is obtained by using the heaviest hammer and the softest packing, the hammer drop being adjusted to suit the allowable stress in the concrete.

Since head-packing materials increase in stiffness with repeated use, optimum driving conditions can be maintained only by regular replacement of the packing.

Failure in the lower sections of a pile can only occur in exceptionally hard driving where in theory the compressive stresses of toe can reach twice the head stresses. In practice, however, this rarely occurs and more than the maximum compressive stress tends to be fairly uniform over a considerable length of the pile.

Longitudinal tension is caused by reflection of the compressive wave at a ' free ' end. Tensile stresses, therefore, may arise when the ground resistance is low and/or when the head conditions result in hammer rebound, that is, with hard packing and light hammer.

In addition, a relatively long length of pile unsupported above a hard stratum may encourage transverse or flexural vibrations which may be set up if the hammer blow becomes non-axial or the pile is not restrained. Piles may be driven with any type of hammer, provided they penetrate to the prescribed depth or attain the specific resistance without being damaged. The hammer, helmet, dolly and pile should be coaxial and should sit squarely one upon the other.' It is always preferable to employ the heaviest hammer practicable and to limit the stroke so as not to damage the pile. When choosing the size of the hammer, regard should be given to whether the pile is to be driven to a given, resistance or to a given depth. The stroke of a single acting or drop hammer should be limited to 1-2 m, preferably 1 m. A shorter stroke with particular care should be used when there is a danger of damaging the pile. The following are examples of such conditions:

- Where in the early stages of driving a long pile, a hard layer near the ground surface has to be penetrated.
- Where there is a very soft ground up to a considerable depth, so that a large penetration is achieved at each hammer blow.
- Where the pile is expected suddenly to reach refusal on rock or other- virtually impenetrable soil.

When a satisfactory set with an appropriate hammer and drop for the last 10 blows has been achieved, repeat sets should only be carried out with caution and long-continued driving, after the pile has almost ceased to penetrate, should be avoided, especially when a hammer of

moderate weight is used. It is desirable that a full driving record be taken on one pile in every hundred driven, and on the first few piles in a new area.

Any sudden change in the rate of penetration which cannot be ascribed to normal changes in the nature of the ground should be noted and the cause ascertained, if possible, before driving is continued

When the acceptance of piling *is* determined by driving to a set, the driving conditions when taking the set should be the same as those used when the sets of test piles were obtained.

The head of precast concrete pile should be protected with packing of resilient material, care being taken to ensure that it is evenly spread and held securely in place. A helmet should be placed over the packing and provided with a dolly of hardwood or other material not thicker than the width of the pile.

Jetting may be used as a means of minimizing or eliminating the resistance at the toe: frictional resistance along the surface of the pile shaft may also be reduced. By reducing the toe resistance very hard driving and vibration can be avoided and greater rates and depths of penetration can be achieved than by percussive methods. Jetting is effective in cohesion less soils such as sand, gravel and fine-grained soils provided the percentage of clay is small; it is not effective in clay soils

Jetting of piles should be carried out only when it is desired and in such a manner as not to impair the bearing capacity of the piles already in place, the stability of the ground or the safety of any adjoining buildings.

The quantity of water required for effective jetting is directly related to the cross sectional area of the piles (including external jet piles); up to 2 litres per minute per square centimeter of pile cross-section may be required at the pile in dense cohesion less soils; loosely compacted soils may require less water. The pressure should be from 5.6 kgf/cm' to 106 kgf/cm* or more. If large quantities of water are used, it may be necessary to make provision for leading away the water that emerges at the ground surface so that the stability of the piling equipment is not endangered by the softening of the ground.

The arrangement of the jets should be balanced to ensure that the pile penetrates vertically. Independent piles surged down or two pipes attached to the opposite sides of the pile may be used. To minimize the risk of blockages the nozzles should not be positioned at the point of the toe. Acceptable verticality may be achieved by the use of rigid leaders and allowing the pile to enter the ground gradually, after operating the water under weight of the pile and hammer, the rate of penetration being controlled by the pile winch. Once maximum apparent penetration is achieved by this method, further penetration may generally be obtained in cohesion less soils by light driving whilst the water jets are running. When jetting is completed the piles should be driven to the final penetration or set.

Jetting should be stopped before completing the driving, which should always be finished by ordinary methods. Jetting should be stopped if there is any tendency for the pile tips to be drawn towards the piles already driven owing to disturbance to the ground.

Jets shall be tested before driving commences. If it becomes necessary to jet a pile which is not provided with built-in-jet, satisfactory results can be obtained by working on independent jet pipes down the outside of the pile, the jet being worked alternatively down the several faces of the pile to assist verticality.

4.0 BASIC PROPERTIES OF DRILLING MUD (BENTONITE)

4.1 PROPERTIES

The bentonite suspension used in bore holes is basically a clay of montmorillonite group having exchangeable sodium cations. Because of the presence of sodium cations, bentonite on dispersion will break down into small plate like particles having a negative charge on the surfaces and positive charge on the edges. When the dispersion is left to stand undisturbed, the particles become oriented building up a mechanical structure at its own. This mechanical structure held by electrical bonds is observable as a jelly like mass or jell material. When the jell is agitated, the weak electrical bonds are broken and the dispersion becomes fluid.

4.2 FUNCTIONS

The action of bentonite in stabilizing the sides of bore holes is primarily due to the thixotropic property of bentonite suspension. The thixotropic property of bentonite suspension permits the material to have the consistency of a fluid when introduced into the excavation and when undisturbed forms a jelly which when agitated become a fluid again.

In the case of a granular soil, the bentonite suspension penetrates into the sides under positive pressure and after a while forms a jelly. The bentonite suspension gets deposited on the sides of the hole and makes the surface impervious and imparts a plastering effect. In impervious clay, the bentonite does not penetrate into the soil, but deposits only a thin film on the surface of the hole. Under such condition stability is derived from the hydrostatic head of the suspension.

4.3 SPECIFICATION

The bentonite suspension used for piling work shall satisfy the following requirements: o The

liquid limit of bentonite when tested in accordance with IS : 2720 (Part V) - 1965* shall be more than 300 percent and less than 450 percent.

- The sand content of the bentonite powder shall not be greater than 7 percent. NOTE - The purpose of limiting the sand content is mainly to control and reduce the wear and tear of the pumping equipment. o Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the bentonite solution should be' about 1.12.
- The Marsh viscosity when tested by a Marsh cone should be about 37 seconds.
- The swelling index as measured by the swelled volume after 12 hours in abundant quantity of water shall be at least 2 times its dry volume.
- The pH value of the bentonite suspension shall be less than 11.5.

5.0 TEST OF PILE

There are two types of tests for each type of loading (that is, vertical, lateral and pull out) namely, initial and routine test.

5.1 INITIAL TEST

This test is required for one or more of the following purposes. This is done in case of important and or major projects and number of tests may be one or more depending upon the number of piles required.

a) Determination of ultimate load capacities and arrival at safe load by application of factor of safety,
b) To provide guidelines for setting up the limits of acceptance for routine tests,
c) To study the effect of piling on adjacent existing structures and takes decision for the suitability of type of piles to be used,
d) To get an idea of suitability of piling system, and
e) To have a check on calculated load by dynamic or static approaches.

5.2 ROUTINE TEST

This test is required for one or more of the following purposes. The number of tests may generally be one-half percent of the total number of piles required. The number of the test may be increased up to 2 percent in a particular case depending upon nature, type of structure and strata condition:

a) One of the criteria to determine the safe load of the pile;
b) Checking safe load and extent of safety for the specific functional requirement of the pile

at-working load; and

c) Detection of any unusual performance contrary to the findings of the initial test, if carried out.

5.3 GENERAL REQUIREMENTS APPLICABLE TO ALL TYPES OF TESTS

Pile test may be carried out on a single pile or a group of piles as required. In case of pile groups, caps will be provided such that the required conditions of actual use are fulfilled.

Generally the load application and deflection observation will be made at the pile top. In particular cases where upper part of pile is likely to be exposed later on due to scour, dredging or otherwise then capacity contributed by that portion of the pile during load test shall be duly accounted for. The pile groups in these conditions shall be tested without their cap resting on the ground.

The test should be carried out at cut-off level wherever practicable, otherwise suitable allowance shall be made in the interpretation of the test results test load if the test is not carried out at cut-off level.

5.4 VERTICLE LOAD TEST

5.4.1 GENERAL

In this type of test, compression load is applied to the pile top by means of a hydraulic jack against rolled steel joist or suitable load frame capable of providing reaction and the settlement is recorded by suitably positioned dial gauges. Maintained load method as given later should be used for determination of safe load. However, for specific requirements cyclic and CRP methods, which are alternate methods, may be used as mentioned later. The general requirements applicable for these three methods are given under here, unless otherwise specified.

5.4.2 Preparation of Pile Head - The pile head should be chipped off to natural horizontal plane till sound concrete is met. The projecting reinforcement should be cut off or bent suitably and the top finished smooth and level with plaster of Paris or similar synthetic material where required. A bearing plate with a hole at the centre should be placed on the head of the pile for the jacks to rest.

5.4.3 Application of Load - (Not applicable to CRP method.) The test should be carried out by applying a series of vertical downward incremental load each increment being of about 20 percent of safe load on the pile. For testing of raker piles it is essential that loading is along the axis.

5.4.4 Reaction - The reaction may be obtained from the following: Kent ledge placed on a

platform supported clear of the test pile.

In case of load test below under-pinned structure, the existing structure if having adequate weight and suitable construction may serve as ken ledge. 'I'he centre of gravity of the ken ledge should generally be on the axis of the pile and the load applied by the jack should also be coaxial with this pile.

Anchor piles with centre-to-centre distance with the test pile not less than 3 times the test pile shaft diameter subject to minimum of 2 m. If the anchor piles are permanent working piles, it should be ensured that their residual uplift is within limits. Care should be exercised to ensure that the datum bar supports are not affected by heaving up of the soil.

Rock anchors with distance from the nearest edge "of the piles at rock level being 2 times the test pile shaft diameter or 1.5 m whichever is greater.

5.4.5 Settlement - (Not Applicable for CRP Test.) Settlement shall be recorded with minimum 2 dial gauges for single pile and 4 dial gauges of 0.01 mm sensitivity for groups, each positioned at equal distance around the piles and normally held by datum bars resting on immovable supports at a distance of 3 D (subject to minimum of 1.5 m) from the edge of the piles, where D is the pile stem diameter of circular piles or diameter of the circumscribing circle in the case of square or non-circular piles.

5.4.6 The safe load on single pile for the initial test should be least of the following:

Two-thirds of the final load at which the total displacement attains a value of 12 mm unless otherwise required in a given case on the basis of nature and type of structure in which case, the safe load should be corresponding to the stated total displacement permissible.

50 percent of the final load at which the total displacement equal 10 percent of the pile diameter in case of uniform diameter piles and 7.5 percent of bulb diameter in case of under-reamed piles.

5.4.7 Maintained Load Method - This applicable for both initial and routine test. In this method application of increment of test load and taking of measurement or displacement in each stage of loading is maintained till rate of displacement of the pile top is either 0.1 mm in first 30 minutes or 0.2 mm in first one hour or till 2 h whichever occur first. If the limit of permissible displacement as given in earlier is not exceeded, testing of pile is not required to be continued further. The test load shall be maintained for 24 h.

5.4.8 Cyclic Method - This method is used in case of initial test to find out separately skin friction and point bearing load on single piles of uniform diameter. The procedure as given in Appendix A or by instrumentation may be used.

5.4.9 CRP Method-This method which is used for initial test is generally considered to be more

suitable for determining ultimate bearing capacity than the maintained load test but the load/deflection characteristics are quite different from those of the maintained load test and cannot be used to predict settlement of the pile under working load conditions. This method should not be included in routine test.

6.0 MEASUREMENT

Payment for piling work will be done as per the Odisha Public Works Department Schedule.

EARTH WORK IN EXCAVATION & BACK FILLING

CONTENTS

1.0 SCOPE

This part of the specification deals with general requirement for earth in excavation in different materials, site grading, filling in areas shown in drawings, filling back around foundations, plinths and approach ramps, conveyance and disposal of excess excavated soil or stacking them properly as shown on the drawings or as directed by the Engineer - in-charge and all operations covered within the intent and purpose of the specifications. The excavation in rock by blasting etc. shall be as per relevant specifications.

2.0 APPLICABLE CODES

The provisions of the latest Indian Standards listed below, but not restricted to from part of these specifications:

IS: 783	Code of practice for laying concrete pipes
IS: 1200	Method of measurement of building and (Part I) Civil Engineering Works - Part I Earth Work.
IS: 1498	Classification and identification of soils for general Engineering purposes.
IS: 2720	Methods of test for soil
IS: 2809	Glossary of terms and symbols relating to soil Engineering.
IS: 3764	Safety code for excavation work
IS: 4081	Safety Code for blasting and related drilling operations
IS: 4988	Glossary of terms and classifications of earth moving machinery

3.0 DRAWING

The Engineer-in-charge will furnish drawings wherever in his opinion such drawings are required to show the areas to be excavated/filled, sequence of priorities etc. The Contractor shall follow such drawings strictly.

4.0 CLASSIFICATION OF EARTH

For purpose of earthwork soil shall be classified as under:

Loose / soft soil: Any soil which generally yields to the application of picks and shovels, phawras, rakes or any such ordinary excavating implements or organic soil, gravel, silt, sand, turf loam, clay, peat etc. fall under this category.

Dense / Hard soil: Any soil, which generally requires the close application of picks, or jumpers or scarifies to loosen it. Stiff clay gravel and cobble stone etc. fall under this category.
(Note: Cobble stones are the rock fragments usually rounded or semi-rounded having maximum diameter in any one direction between 80 & 300mm)

Mud: Mud is a mixture of ordinary soft soil and water in fluid or weak solid state.

Soft / Disintegrated rock (Not requiring blasting): This shall include the type of rock and boulder, which may be quarried or split with crowbars. Laterite, hard conglomerate and amygdaloidal basalts also come under this category.

Hard rock (Requiring blasting where blasting is prohibited): Under this category shall fall hard rocks, which though normally requires blasting for their removal but blasting is prohibited and excavation has to be done by chiseling, wedging or other suitable method.

5.0 GENERAL

5.1 The Contractor shall furnish all tools, plant, instruments, qualified supervisory staff, labor, materials, any temporary works, consumable and everything necessary, whether or not such items are specifically stated herein, for completion of the job in accordance with the specification requirements.

5.2 The Contractor shall carry out the surveys of the site before excavation and set out properly all lines and establish levels for various works such as earth work in excavation for grading, foundations, plinth filling, road drains, cable trenches, pipe lines, culverts, retaining walls etc. Such surveys shall be carried out taking accurate cross sections of the area perpendicular to the grid lines at intervals determined by the Engineer-in-Charge, depending on the ground profiles. These will be checked by the Engineer-in-Charge or his representative and thereafter properly recorded.

5.3 The excavation shall be done to correct lines and levels. This shall include where required, proper shoring to maintain excavation and also the furnishing, erection and maintaining of substantial barricades around excavations and warning lamps at night for safety purposes.

5.4 The rates quoted shall include for dumping of excavated material in regular heaps, bunds, and rip rap with regular slopes as directed by the Engineer-in-charge within the lead specified and leveling the same so as to provide natural drainage. Rock/ soil excavation shall be properly stacked as directed by the Engineer-in-charge. As a rule all softer materials shall be laid along the centre of the heaps, the harder and more resistant materials, forming the casting on the sides and the top. Rock shall be stacked separately.

6.0 CLEARING

The area to be excavated / filled shall be cleared of all fences, trees, plant logs, stumps, bush, vegetation, rubbish, slush etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall be removed. The material so removed shall be disposed off as directed by the Engineer-in-charge. Where earth fill is intended, the area shall be cleared of all loose or soft patches, top soil containing objectionable matter/ materials before filling commences. No separate payment shall be made for such clearing works.

7.0 PRECIOUS OBJECTS, RELICS, OBJECTS OF ANTIQUITIES ETC.

All gold, silver, oil, minerals, archaeological and other findings of importance or other materials of any description and all precious stones, coins, treasures trove, relics, antiquities and similar things which may be found in or upon the site shall be property of the Employer and the Contractor shall duly preserve the same to the satisfaction of the Engineer-in-charge and from time to time deliver the same to him.

8.0 EXCAVATION FOR STRUCTURES

8.1 DESCRIPTION: Excavation for structures shall consist of removal of materials for the construction of the foundations, retaining walls, pipe trenches, tunnels and other similar structures in accordance with the requirements of this specification and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall include construction of shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstruction necessary for placing the foundations, trimming bottoms of excavation; backfilling, cleaning up the site and disposal of all surplus materials.

8.2 SETTING OUT: After the site has been cleared as per clause 5 above, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The Contractor shall provide all labour, survey instruments and materials such string, pegs, nails, bamboo, stones, lime, mortar, concrete etc. required in connection with the setting out of works and establishment of bench marks. The Contractor shall be responsible for the maintenance of bench marks and other marks and stakes as long as they are required for the work in the opinion of the Engineer in- charge.

8.3 EXCAVATION: Excavation shall be taken to the width of the lowest step of footing or the pile caps and the sides shall be left plumb where the nature of the soil allows it. Where the nature of the soil or the depth excavated trench/ pit does not permit vertical sides, the Contractor at his own expense shall put up the necessary shoring, strutting and planking or cut slopes to a safe angle or both with due regard to the safety of personnel and the works and to the satisfaction of the Engineer-in-Charge. the depth to which the excavation is to be carried out shall be as shown on the drawings unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer-in-Charge.

8.4 DEWATERING AND PROTECTION: Where water is met within excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, construction of diversion channels, drainage channels, bunds and other necessary works to keep the foundation trenches/ pits dry when so required and to keep the green concrete/ masonry against damage by erosion or sudden rise of water level. The method to be adopted in this regard and other details thereof shall be left to choice of the Contractor but subject to the approval of the Engineer-in-charge.

8.5 Approval of the Engineer-in-charge shall, however, not relieve the Contractor of his responsibility for the adequacy of dewatering and protection arrangements and the safety of the works. Pumping from inside of any foundation enclosure shall be done in such a manner as to preclude the possibility for the movement of water through any freshly placed concrete. No pumping shall be permitted during the placing of concrete or any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or similar means. At the discretion of the Contractor and at his cost, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area. The Contractor shall take all precautions in diverting channels and in discharging the drained water so as not to cause damage to the works or to adjoining property.

8.6 PREPARATION OF FOUNDATION: The bottom of the foundation shall be leveled both longitudinally and transversally or stepped as directed by the Engineer-in-charge. Before the footing is laid, the surface shall be slightly watered and rammed. In the event of the excavation having been made deeper than that shown on the drawing or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete of the foundation grade at the cost of the Contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level.

When rock or other hard strata is encountered, it shall be freed of all loose and soft materials, cleaned and cut to a firm surface either level, stepped, or serrated as directed by the Engineer- in-charge. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer-in-charge.

8.7 SLIPS & BLOWS: If there are any slips or blows in the excavation, these shall be removed by the Contractor at his own cost.

8.8 BACK FILLING: To the extent available, selected surpluses soil from the excavation shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign materials. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 75 mm size mixed with properly graded fine materials consisting of moorum or earth fill up the voids and the mixture used for filling.

If any selected fill is required to be borrowed, the Contractor shall make arrangement for bringing the material from outside borrow pits. The material sources shall be subject to the prior approval of the Engineer-in-Charge. The Contractor shall make necessary access roads to such borrow areas at his own cost, if such access roads do not exist.

Use of surplus selected soil from excavated stuff for backfilling can be permitted only up to the original ground level. Above this level, only selected borrowed material shall be used.

Backfilling of the foundation/ pits shall be done as soon as the foundation work has been completed to the satisfaction of the Engineer-in-Charge and measured but not earlier than the full setting of the concrete or masonry of the foundation. Backfilling shall be carried out in such manner as to not cause undue thrust on any part of the structure. Backfilling shall be done in space around the foundations after clearing it of all debris and in layers of 150 mm. loose thicknesses, watered and compacted to the satisfaction of the Engineer in charge and to the original surface. For embankments, initially the top width is to be increased by 600mm on either side for enabling proper compaction upto the edge. The embankment shall be cut and sectioned for correct profile. This additional earthwork on either side of 600mm width shall not be paid for and shall be included in the respective item of road work quoted by the tenderer. The slopes of embankment shall be compacted by using mechanical earth compactors of adequate capacity wherever necessary as directed by the Engineer-in-charge.

8.9 DISPOSAL OF SURPLUS EXCAVATED MATERIALS: All the excavated material shall be the property of the employer. Where the excavated material is directed to be used in the construction of the works for general grading, plinth filling or embankments, the operation shall be arranged in such a manner that the capacity for cutting, haulage and compaction are nearly the same.

All hard materials such as hard moorum, rubble etc. not intended for filling in foundations, plinth or embankments shall be stacked neatly for future use as directed by the Engineer in-Charge within the lead specified. Unsuitable or surplus materials not intended for use in part of the works or for reuse shall be disposed off outside the complex as directed by the Engineer-in-Charge.

9.0 MEASUREMENT & RATES

The measurement shall be generally confirming to IS: 1200 Part-I unless otherwise specified. Measurement for excavation of foundations and footings shall be as required for the exact width, length and depth as shown or figured on the drawings or as may be directed by the Engineer-in-Charge. If taken out to a greater width, length or depth than shown or required, the extra work occasioned thereby shall be done at the Contractor's expenses.

The dimensions of the trenches and pits shall be measured correct to the nearest cm. and cubical contents worked out in cubic meters, correct to two places of decimal.

Footings. : Area of excavation for footing shall be measured equally to the area of the lowest concrete course as shown on the drawing -Depth shall be measured vertically from ground level to bottom of concrete course or dry rubble packing or brick flat soling as the case may be.

Plinth Beams : Depth of excavation for plinth beam shall be measured from ground level up to bottom of beam and width equal to width of beam. If a leveling course is ordered. It shall be measured up to the bottom of the leveling course.

Where the excavations is made in trenches, measurements for cutting shall be taken by means of taps and staff and after completion of work and total quantity of excavation computed from these levels in manner approved by the architect/Employer.

Where excavation is made for leveling the site, levels shall be taken before start and after completion of work and work and total quantity of excavation computed from these levels in manner approved by the Architect.

Where soil including soft rock is mixed hard rock after excavation shall be stacked separately. Measurement of the entire excavation shall be taken as indicated above. Excavation of hard rock shall be measured from stacks of excavated hard rock and reduced by 40% for bulkage and voids. The quantity so arrived at shall be paid for under hard rock. The quantity so arrived at shall be paid as soil including and quantity payable under hard rock shall be paid as soil including soft rock.

Any additional excavation required for working space from work showing, planning, dewatering etc, shall not be measured for separately. Rates quoted for excavation shall include all these factors and filling back the trenches with available soil.

To open spaces: Filling shall be measured from cross sections of embankment, levels of which are recorded by means of levels before start of work and after completion of work. When it is not possible to measure filling from cross sections, it may be measured from loose stack of lorry measurements with previous written permission from the Owner's Engineer and 20% deduction shall be made from the measured quantity to arrive at the net quantity payable.

Rate for earthwork shall include the following:

- Excavation and disposing earth as specified. oSetting out works, profiles etc.
  - Site clearance such as cleaning of rank vegetation, shrubs, bush wood.
- Forming (or leaving) “Dead men” or “Tell Tales” and their removal after measurement
- Bailing/ pumping out water in excavation from rains, sub-soil water etc.
- Protection, temporarily supporting of existing service, i.e. pipes, water mains, cables etc. met within the course of excavation. Care shall be taken not to disturb electric and communication cables, removal of such cables, if necessary, shall be arranged by the Engineer-in-charge. oForming (or leaving) steps in sides of deep trenches and their removal: o Removing slips or falls in excavation. o Fencing and/or suitable measures for protection against risk of accidents as approved by the Engineer-in-charge.
- Excavation for insertion of planking and strutting where required o Backfilling the trenches with selected excavated material.

PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT

CONTENTS

1.0 CHEMICALS

The chemicals used for the soil treatment shall be any one or combination of the following with the concentration shown against each aqueous emulsion:

Chemicals	Concentration:
Endosulfan 35EC	0.5% (by weight)
Chlorpyrifos 20 EC	1.0% (by weight)

The tender shall clearly indicate along with the quotation the chemical he proposed to use. A daunt record shall be maintained by the Contractor indicating the amount of work done and the quantity of chemical consumed for the work. This record shall be the property of the employer.

2.0 TREATMENT OF COLUMN PITS, WALL TRENCHES & BASEMENT EXCAVATION

The bottom surface and sides (up to a height of 30 cm from the bottom) of the excavations made for column pits, trenches and basements shall be treated with the chemical emulsion mentioned above at 5 liters/ sq. meter of surface area.

3.0 TREATMENT TO BACK FILL EARTH

After the column foundations, wall foundations and retaining walls of the basement come up, the backfill in immediate contact with the foundation structure shall be treated with the chemical emulsion at the rate of 15 litres/ sq.m of the vertical surface of the sub-structure for each side. The earth is usually returned in layers and each side. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

4.0 TREATMENT FOR R.C.C FRAMED STRUCTURE

The treatment described in 2 and 3 above applies essentially to masonry foundations where there are voids in the joints through which termites can seek entry into the superstructure. Hence the foundations require to be completely enveloped by a chemical barrier. In the case of RCC framed structures with columns and plinth beams RCC basements the concrete mix is rich and dense (being 1:2:4 or richer), it is unnecessary to start the treatment from the bottom excavations for columns, plinth beams and basement walls. The treatment shall start at depth of 50cm below ground level. From this depth, the backfill around the columns, beams and RCC basement walls shall be treated at the rate of 15 liters/ sq.m. of the vertical surface. The other details of the treatment shall be as laid down in 3 above.

5.0 TREATMENT OF TOP SURFACE OF PLINTH FILLING

After the earth filling is completed in the plinth area and before the dry rubble packing or Sub grade is laid; the entire surface of the filled earth shall be treated with the chemical emulsion at the rate of the 5 litres per sq.m. Light rodding may be carried out in the soil surface to facilitate absorption of the emulsion.

6.0 TREATMENT AT JUNCTION OF WALLS & FLOOR

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surface from the ground level (where it had stopped with the treatment described in 3 above) upto the level of the filled earth surface. To achieve this, a small channel 3 x 3 cm shall be made at all the junctions of wall and columns with floor (before laying the subgrade) and rod holes made in the channel up to the ground level 15 cm apart and the rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 15 liter/ sq.m of the area of the vertical surface of the wall surface of the sub-structure so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.

7.0 TREATMENT OF SOIL ALONG EXTERNAL PERIMETER OF BUILDING

Finally the earth around the external perimeter of the building up to a depth of 30cm shall be treated at the rate of 4.5 liter per running meter of plinth wall. To facilitate this treatment, solid M.S. rods should be driven into the soil as close as possible to plinth wall at intervals of 15 cm and up to a depth of 30 cms and the rods moved backwards and forwards in a direction parallel to the wall to break up the earth so that the chemical emulsion mixes intimately with soil.

8.0 TREATMENT OF SOIL SURROUNDING PIPES WASTES AND CONDUITS

When pipes, wastes and conduits enter the soil inside the area of the foundation, the soil Surrounding the point of entry must be loosened around each such pipe waste or conduit for a distance of 15 cm and upto a depth of 7.5 cm before the 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 7.5 cm for a distance of over 30cm.

9.0 SPRAYING EQUIPMENT

A pressure pump shall be used to carry out spraying operations to facilitate proper penetration of chemicals into the earth.

The above specifications are in line with the IS code of Practice for Anti-termite Measures in Building, IS 6313 (Part II) - 1981.

10.0 MEASUREMENT & RATE

The item shall be measured in sq. metre area. Plinth area of building at ground floor will be measured and paid for.

PLAIN & REINFORCED CEMENT CONCRETE

CONTENTS

1.0 GENERAL

These specifications cover the requirement of plain & reinforced concrete for use in various components of structures. For all items of concrete in any portion of the structure or its associated works controlled concrete shall be used unless otherwise specified. When ordinary concrete of the mix is shown on drawings or directed by the Engineer, the same may be used. The provision of the latest revision of the following IS Codes shall from a part of this specification to the extent they are relevant.

IS – 226 Specification for structural steel (standard quality)
IS – 269 Specification for ordinary and low heat Portland cement
IS – 280 Specification for mild steel wire for general engineering purpose IS – 303 Plywood for general purposes
IS – 383 Specification for coarse and fine aggregate
IS – 432 (All Parts) - Specifications for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
Part – I : Mild steel and medium tensile bars
Part – II : Hard drawn steel wire
IS – 455 Specification for Portland blast furnace slag cement
IS – 456 Code of practice for plain and reinforced concrete for general building construction
IS – 460 Specification for test sieves
IS – 516 Methods of test for strength of concrete IS – 650 Standard sand for testing of cement
IS – 1139 Hot rolled mild steel, medium tensile steel and HYSD bars for concrete reinforcement
IS – 1199 Sampling and analysis of concrete
IS – 1200 Part II Method of measurement of building works IS – 1343 Code of practice for prestressed concrete
IS – 1489 Specification for Portland pozzolana cement
IS – 1542 Sand for plaster
IS – 1566 Specification for hard - drawn steel wire fabric
IS – 1732 Dimensions for round & square steel bars for structural & general engineering purposes.
IS – 1785 Plain hard drawn steel wire prestressed concrete (Part I) Cold drawn stress - relieved wire.
IS – 1786 Specification for high strength deformed steel bars & wires for concrete reinforcement
IS – 1791 Batch type concrete mixers
IS – 2062 Weldable structural steel
IS – 2386 (8 Parts) Method of test for aggregates for concrete
IS – 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
IS – 2505 Immersion type concrete vibrators IS – 2506 Screed board concrete

vibrators

IS – 2722 Specification for portable swing weigh batcher (Single and double bucket type)

IS – 2751 Code of practice for welding of MS bars

IS – 2911 Code of practice for design and construction of pile foundation IS – 3366 Pan Vibrators

IS - 3370 (All Parts) Code of practice for concrete structure for the storage of liquids.

IS – 3558 Code of practice for the use of immersion vibrators for onsolidating concrete.

IS – 4656 Form vibrators for concrete

IS – 4926 Ready Mixed Concrete

IS – 5525 Recommendation for detailing of reinforcement in reinforced concrete works.

IS – 5640 Method of test for determining aggregate impact value of soft, coarse aggregate.

IS – 5816 Methods of test for splitting strength of concrete cylinder

IS – 6006 Uncoated stress relieved strand for pre-stressed concrete. IS - 6461 Cement concrete : glossary of terms

IS – 6925 Methods of tests for determination of water soluble chlorides in concrete admixtures.

IS - 8041 Specifications for rapid hardening Portland Cement

IS - 8043 Specifications for hydrophobic Portland Cement

IS - 8112 Specification for high strength ordinary Portland cement. (43 grade OPC)

IS - 9103 Admixtures for concrete.

IS - 12269 Specification for high strength ordinary Portland cement. (53 grade OPC).

1.1 OTHER CODES & SPECIFICATION

Other IS codes pertaining to the items of cement concrete work in structural work and not listed above shall also be deemed to come under the preview of this clause. All Indian Roads Congress Standards, Specifications and codes of practice also come under this purview

2.0 GRADE OF CONCRETE

Controlled concrete of minimum grade M-20 design mix shall only be used for all reinforced & plain cement concrete works. In the event of design mix cannot be used for any reason on the work, for grades M20 or lower, nominal mix may be permitted at the discretion of the Engineer-In-Charge.

2.1 Controlled Concrete: For controlled concrete, design of the mix shall be arrived at after preliminary tests and in its production all necessary precautions shall be taken to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in grades designated as M20, M25, M30, M35, M40, M45 and M50.

2.2 Ordinary Concrete: In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume. The ordinary concrete shall be in grades designated as M10 and M 15 with the suffix 'Ordinary' added to it. It can also be specified by volume as given in Table 3 of this specification. In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in N/sq.mm.

3.0 STRENGTH REQUIREMENT OF CONCRETE

Where Ordinary Portland Cement conforming to IS: 269 or Portland Blast Furnace Cement conforming to IS : 456 is used, the compressive strength requirements for various grades of concrete controlled as well as ordinary shall be as given in Table 1. Where rapid hardening Portland cement is used, the 28 days compressive strength requirements specified in Table 1 shall be met at 7 days.

For controlled concrete, the mix shall be so designed as to attain in preliminary tests strength at least 33 percent higher than that required on work tests, for concrete upto and including M25 and 25 % higher for higher strengths. Preliminary tests need not be made in case of 'ordinary concrete'.

TABLE-1

Grade of concrete	Compressive works test strength in N/sq.m mm on 150mm cubes after testing conducted in accordance With IS: 516	
	Min at 7 days	Min at 28 days
M10	7	10
M15	10	15
M20	13.5	20
M25	17	25
M30	20	30
M35	23.5	35
M40	27	40
M45	30	45
M50	33.5	50

Note: In all cases, the 28 days compressive strength specified in Table 1 shall alone be the criterion for acceptance or rejection of the concrete. Where the strength of a concrete mix, as indicated by tests, lies between the strength for any two grades specified in table 1, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

4.0 MATERIALS

4.1 CEMENT: All types and brands of cement shall be subjected to the approval of the Engineer-in-charge.

A) Following types of Cement shall be used.

- All cement used for the work shall be ordinary Portland cement or such other cement as may be permitted by the Engineer-in-charge. Portland Cement shall comply with requirements of the latest issue of IS 269. High alumina cement, rapid hardening cement and Portland Slag cement etc., can be used only when permitted by the Engineer-in-charge. Such cements shall be in accordance with relevant IS codes. Portland Pozzolana cement when permitted by the Engineer-incharge shall conform to IS 1489.
- Cement which has remained in bulk storage at the mill for more than 6 months, or which has remained in bags at the dealer's storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-tested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications.
- The Cement to be used in the work shall be of grade not less than Grade 43 which shall be got approved by the Engineer-in-charge.

4.2 FINE AGGREGATES: Fine aggregates shall consist of natural sand, manufactured sand, or an approved combination thereof and shall conform to IS: 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in- charge.

The sand shall be of siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be mechanically washed, unless specific written authority is given by the Engineer in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

4.3 COARSE AGGREGATES: Coarse aggregates shall consist of hard, strong, durable particles of crushed stone and shall be free from thin elongated soft pieces, organic or other deleterious matter. It shall not have adherent coatings. It will be from a source approved by the Engineer-in-charge.

Coarse aggregate shall conform to IS: 383

Coarse aggregate shall be washed if necessary to remove all vegetation and other perishable substances and objectionable amounts of other foreign matter, the cost of washing and screening being borne by the contractor.

4.3.1 SIZE OF COARSE AGGREGATE: The nominal maximum size of coarse aggregate should be as large as possible within the limit specified but in no case greater than one fourth of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. In no case nominal maximum size of coarse aggregate shall be greater than 20mm. For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars, or 5 mm less than the minimum cover to the reinforcement, whichever is smaller. However, if required under special circumstances, the Engineer-in-Charge may permit nominal maximum aggregate size of 25% more than this critical spacing/ cover, provided that proper vibrating is ensured.

4.4 REINFORCING STEEL: Reinforcing steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coating, which may impair or reduce bond.

- Mild steel and medium tensile steel bars and hard drawn steel wire shall conform to the latest edition of IS: 432.
- High strength steel deformed bars shall conform to IS: 1786 o Hard drawn steel wire fabric shall conform to IS :1566 o Structural steel sections and plates shall conform IS: 226 and IS: 2062.
- Hot rolled mild steel medium tensile steel and high yield strength steel deformed bars shall conform to IS : 1139.

4.5 WATER: Water for mixing Cement/lime/ Surkhi mortar or concrete shall not be salty or brackish and shall be clean, reasonable clean and free from objectionable quantities of slit traces of oil, acid and injurious alkali, salts, organic matter and other deleterious materials which will either weaken the mortar or concrete on cause efflorescence or attack the steel in reinforced cement concrete water shall be obtained from sources approved by the Architect portable water is generally considered satisfactory for mixing and curing concrete, mortar, masonry etc. Where water other than Municipal source is used this shall be tested in an approved testing laboratory to establish its suitability.

All charges connected herewith shall be borne by the Contractor.

4.6 ADMIXTURES: No materials other than the essential ingredients, i.e., cement, aggregates and water, shall ordinarily be used in the manufacture of concrete or mortar. But the Engineer-in-charge may permit the use of approved admixtures confirming to IS : 6925 for imparting special characteristics to the concrete, on satisfactory evidence that its use does not in any way adversely affect the properties of concrete particularly its strength, volume changes, durability and has no deleterious effect on the reinforcement. Admixtures where allowed will generally be conforming to relevant ASTM standards and IS : 9103.

4.7 MATERIALS FOR REPAIR WORKS: The use of epoxy for bonding fresh concrete used for repairs will be permitted on written approval of the Engineer-in Charge. Epoxies shall be applied in accordance with the instructions of the Manufacturer. The cost of such repair when approved by the Engineer-in-charge shall be borne by the contractor.

4.8 STORAGE OF MATERIALS

- CEMENT: The contractor shall make arrangements to the satisfaction of Engineer-in-charge for the storage of cement to prevent deterioration due to moisture and/or intrusion of foreign matter. Bulk cement shall be stored in approved waterproof bin or silo. Bagged cement shall be stored in a suitable weather tight warehouse in a manner to provide easy access for identification and inspection of each consignment. Stored cement shall meet the test requirements as per IS - 269 at any time after storage, when a retest is ordered by Engineer- incharge. Each consignment shall be stacked separately with the date of receipt of flagged on it, not more than 12 bags being stacked height, the bags being arranged with header and stretchers. Normally consignments shall be used in the order of receipt at site unless otherwise directed. In case of large concrete pours the Engineer-in-Charge will decide on the batch of cement to be used taking into consideration the quantity of cement with particular reference to the concerned concrete pours. Any additional work in handling and storage of cement contingent upon this requirement shall be to the contractors' account and no extra claim will be entertained. Cement shall be protected from exposure to moisture in transit, in storage at the works and until; it enters the concrete mixes. The contractor shall keep accurate record of the deliveries of the cement and of its use in the work.

- AGGREGATES: Coarse and fine aggregates shall be stacked separately in such manner as to prevent contamination by foreign materials. All aggregates shall be stored on concrete or masonry platforms. Each size shall be kept separate with wooden, steel, concrete, or masonry bulk heads, or shall be stored in separate stacks, taking care to prevent the materials at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart. The aggregates shall be stored in easily measurable stacks of suitable heights as may be directed by the Engineer-in-Charge.

- REINFORCING STEEL: Reinforcing steel shall not be stored directly on the ground. These shall be stored under cover and shall be protected from rusting, oil, grease and distortions as directed by the Engineer-in-Charge.

5.0 PROPORTIONING CONCRETE

5.1 CONTROLLED CONCRETE: Concrete mix shall be designed on the basis of preliminary tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available.

Except where it can be shown to the satisfaction of Engineer-in-charge that a supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions as required. The different sizes, shall be stocked in separate stock piles. Required quantity of material shall be stockpiled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for given job being determined by the Engineer-in-Charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests. In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean, and serviceable condition. Their accuracy shall be periodically checked.

It is most important to keep the specified water-cement ratio constant and at is correct value. To this end, the moisture content in both fine and coarse aggregates shall be determined by Engineer-in-Charge according to weather conditions. The amount of mixing water shall than be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS 2386 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content.

The minimum quantity of cement to be used shall not less than 260 Kg/cum for plain concrete and not less than 340 Kg/cum for reinforced concrete structural members subject to a maximum limit of 540 Kg/cum.

5.2 ORDINARY CONCRETE: The ordinary concrete mix shall generally be specified by volume. For cement, which normally comes in bags and used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meter in volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for bulking shall be made as per IS : 2386 (Part III).

Ingredients required for ordinary concrete containing one (50kg.) bag of cement for different proportions of mix shall be as given in Table 3.

Grade of concrete	Total qty. of dry aggregates by volume per 50 kg. cement to be taken as the sum of individual vol. of fine & coarse aggregate (max.)	Proportion of fine aggregate to coarse aggregate.	Quantity of water per 50 Kg of cement max.**
M10	300 Ltr	Generally 1:2 for fine aggregate to coarse aggregate by volume but subject to upper limit of 1:1.5 and lower limit of 1:2.5 *	34 Ltr
M15	220 Ltr		32 Ltr
M20	160Ltr		30 Ltr
M25	100 Ltr		27 Ltr

* The proportions of the aggregate shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

** The amount of water should be kept minimum required for proper workability. The quantity given in col. 4 is not to be exceeded.

EXAMPLE

For an average grading of the fine aggregate (that is Zone II of IS:383-1963) the proportions shall be 1:1.5, 1:2 and 1:3, for maximum size of aggregates 10mm, 20 mm and 40 mm respectively.

Note: A mix leaner than M10 (1:3:6) may be used for non-structural parts if specified on the drawing or provided in the contract. In such case grading of aggregate shall be as specified in the contract or on the drawings. Other requirements for mixing, placing and curing shall be the same as specified in this section.

5.3 QUANTITY OF WATER: The quantity of water shall be just sufficient to produce a dense concrete of required workability and strength for the job. An accurate and strict control shall be kept on the quantity of mixing water.

In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips, all reinforcement. The degree of consistency, which shall depend upon the nature of work and the methods of vibration of concrete, shall be determined by regular slump tests. The following slumps shall be adopted for different types of works.

SL NO	TYPE OF WORK	SLUMPS	
		Where Vibrators are used	Where Vibrators are not used
1	Mass concrete in RCC foundations, footings & retaining walls.	10mm to 25mm	80mm
2	Beams, slabs & columns simply reinforced	25mm to 40mm	100mm to 120mm
3	Thin RCC section or section with congested steel	40mm to 50mm	125mm to 150mm

Note: With use of ordinary concrete the slump requirement specified above would not be applicable.

6.0 MIXING CONCRETE

For all works concrete shall be mixed in a mechanical mixer, which along with other accessories shall be kept in first class working condition and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and a uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows a complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2

minutes after all ingredients have been put into the mixer. In hand mixing quantity of cement shall be increased by 10% above that specified in clause 5.2 above, the cost of increased cement being borne by the Contractor. Hand mixing will be permitted only under exceptional conditions and the contractor must take the permission of the Engineer-in-charge in advance. Mixers, which have been out of use more than 30 minutes, shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge, the first batch of concrete from the mixer shall contain only two thirds of the normal quantity of coarse aggregate. The mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

6.1 All structural concrete shall be weigh batched. All ingredients for concrete shall be batched by weight using a weigh batcher of approved make conforming to IS : 2722. Batching shall be to an accuracy of 0.50kg and the weigh batcher shall be tested for accuracy of calibration before commencement of the works and at least once a week thereafter or more frequently if so required by the Engineer.

6.2 Use of Ready Mixed Concrete (RMC) may be permitted at the discretion of the Engineer-In-Charge without any extra cost.

7.0 TRANSPORT, PLACING AND COMPACTION OF CONCRETE

The method of transporting and placing concrete shall be approved by the Engineer in charge. Concrete shall be transported and placed such that no contamination, segregation or loss of its constitute materials takes place

All formwork and reinforcement contained in it shall be cleaned and made free from standing water or dust, immediately before placing of concrete. No concrete shall be placed in any part of the structure until the approval of the Engineer in- charge has been obtained in writing.

If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting shall then proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete, which has been in position for more than 30 minutes unless a proper construction joint is formed.

Concrete when deposited shall have a temperature of not less than 4.5 deg. C and not more than 38 deg. C unless otherwise specified. It shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried on properly designed agitators, operating continuously, in which case this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator.

Except where otherwise agreed to by the Engineer-in-Charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 m when internal vibrators are used and not exceeding 0.30m in all other cases.

Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters. When trunking or chutes are used, they shall be kept clean and used in such a way as to avoid segregation.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without the use of an excessive quantity of water and without any segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork. When concreting has to be resumed on a surface, which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a layer of neat cement grout and placed immediately before placing of new concrete.

Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed, and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness, and shall be well rammed against old work, particular attention being given to corners and close spots.

All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrator. For exceptional cases, where vibrators cannot be used an alternate scheme of compaction shall be approved by the Engineer-in-charge. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break down.

The performance requirements of vibrators shall conform to relevant IS codes. Vibration shall not be applied through reinforcement, and where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided as far as practicable.

8.0 EXPANSION JOINTS

Expansion joints shall be provided where shown on the drawings. They shall be constructed with an initial gap between the adjoining parts of the works of the width specified in the drawings. The contractor shall ensure that no debris is allowed to enter and be lodged in expansion joints.

Expansion joints shall be provided with approved joints filler, a joint sealing compound.

8.1 OPEN JOINT FILLER: Where shown on the drawings, open joints in the structure shall be filled with one of the following of approved expansion joint fillers :- o In internal areas a material conforming to IS:1838 Part-I, containing Sikadur combiflex SG (150mm x 2 mm) with supporting epoxy adhesive Sikadur 31C on top & bottom at the both side of expansion joint gap . There should be a minimum overlap of 50mm to either side of the supporting wall/slab/beam. The item also includes Fixing of aluminum sheet over the combiflex fixed area with one side free with slotted arrangement & other side fixed to provide protection against mechanical abasement.

- The joints filler shall be easily and uniformly compressible to its original thickness, tampable, easily cut or sawn, robust, durable, resistant to decay due to termite or weathering, unaffected by water and free of any constituent, which will bleed into or stain the concrete.
- The joint filler shall be of same thickness of the joint width, it shall extend through the full thickness of the concrete unless otherwise specified and shall be sufficiently rigid during handling and placing to permit the formation of straight joints.

8.2 JIONT SEALING COMPOUND: Joint sealing compounds shall be in accordance with the IS:3037:1986 and approved by the Engineer and shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering.

Where so specified joints shall be sealed with approved polysulphide liquid polymer, stored, mixed, handled, applied and cured strictly in accordance with the manufacturer's printed instructions. Such joints shall be formed to the correct dimensions, thoroughly cleaned and treated with recommended primer. The contractor shall use only competent personnel experienced in the application of polysulphide sealant for such work.

Where specified in the drawings, rubber / bituminous based sealants shall be of an approved manufacturer. The treatment of the joint and the use of sealing compound shall be strictly in accordance with the manufacturer's printed instructions.

9.0 CURING OF CONCRETE

9.1 PROTECTION & WATER CURING

Immediately after compaction, concrete shall be protected against harmful effect of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes and premature dying out. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 21 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 21 days.

9.2 STEAM CURING

When steam curing is adopted it shall be ensured that it is done in a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be from two to four hours after the final placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased from four to six hours. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete, and the ambient air temperature shall increase at a rate not exceeding 5 deg. cent. per hour until a maximum temperature of 60 deg. cent. to 70 deg. cent is reached. The maximum temperature shall be maintained until the concrete has reached the desired strength.

When steam curing is discontinued the ambient air temperature shall not drop at a rate exceeding 5 deg. cent per hour until a temperature of about 10 deg. cent above the temperature of the air to which the concrete will be exposed, has been reached.

10.0 WORKING IN EXTREME WEATHER

When depositing concrete in very hot weather, precaution shall be taken so that the temperature of wet concrete does not exceed 38 deg. C. while placing. This shall be achieved by stacking aggregate under sheds and keeping it moist using cold water or crushed or flaked ice if specified and permitted by the Engineer, reducing the time between mixing and placing to the minimum, cooling formwork by sprinkling water on the exterior, starting curing before the concrete dries out and restricting concreting, as far as possible, to mornings and evenings.

During hot weather and rains the concrete shall be covered with tarpaulin and transported and placed in the forms and consolidated to final state in as short a time as possible. Commencement of concrete pours shall be avoided during heavy rains, storms and high winds.

11.0 FINISHING

11.1 GENERAL

Immediately after the removal of forms, all exposed bars or bolts passing through the reinforced cement concrete member and used for shuttering or any other purpose shall be cut inside the reinforced cement concrete member to a depth of at least 25 mm below the surface of the concrete and the resulting holes be closed by cement mortar. All fins caused by form joints shall be broken. All cavities produced by the removal of form ties, all holes and depressions, honeycomb spots, broken edges or corners and all other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been filled/ pointed shall be kept moist for period of twenty-four hours. Any repair and rectification of defective work is to be undertaken and carried out as directed by the Engineer-in-charge and the cost is to be borne by the contractor.

If rock pockets/ honeycombs, in the opinion of the Engineer-in-charge, are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the affected portion of the structure.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left exposed for its full length with clean and true edges. The contractor shall be responsible for providing an adequate key in concrete where plastering or rendering is specified to be applied. Hacking of the concrete surface after striking the formwork will be permitted only after seven days after concrete is done. Curing of the surface shall be continued for a period of

21 days.

11.2 CLASSES OF FINISHING

The surface finish for formed and unformed surfaces are classified and defined as below.

Surface irregularities permitted for the various classes of finishes are termed either "abrupt" or "gradual". Fins or offsets caused by displaced or misplaced from sheeting, lining or form sections, by loose knots in form timber or by otherwise defective form timber are considered abrupt irregularities. All other cases are described as gradual irregularities. Gradual irregularities will be measured with a template consisting of a straight edge for plane surfaces or its equivalent for curved surfaces. The length of template for testing gradual irregularities on formed surfaces shall be 1.5 m in length, the permissible gradual irregularities being measured over this length of the template. Special surfaces, finishes and treatments falling outside the classes described here but defined elsewhere by the Engineer-in-charge shall also form part of these specifications.

12.0 CONSTRUCTION JOINTS

Concreting shall be carried out continuously upto the construction joints, the position and details of which shall be as shown on approved drawings or as directed by the Engineer-in-Charge. Such joints shall, however, be kept to the minimum.

For a vertical construction joint, a stopping board shall be fixed previously at the predetermined position and shall be properly stayed for sufficient lateral rigidity to prevent its displacement or bulging when concrete is compacted against it. Concreting shall be continued right up to the board. The board shall not be removed before the expiry of the specified period for removal of vertical forms. Before resuming work at a construction joint where the concrete has not yet fully hardened, all laitance shall be removed thoroughly, care being taken to avoid dislodgement of coarse aggregates. When work has to be resumed on a surface, which has hardened, the surface shall be thoroughly hacked, swept clean, wetted and covered with a layer of neat cement grout. The first batch of concrete shall be rammed against the old work to avoid formation of any stone pockets, particular attention being paid to corners and close spots.

In all cases, the position and detailed arrangement of all construction joints shall be predetermined and got approved by the Engineer-in-Charge.

13.0 TESTS AND STANDARDS OF ACCEPTANCE

13.1 Preliminary Tests for Controlled Concrete: For controlled concrete preliminary tests referred to in Paras 2.1 & 3.0 shall consist of three sets of separate tests, and in each set tests shall be conducted on six specimens. Not more than one set of six specimens shall be made on any particular day. Of the six specimens in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests of 7 days are intended only to indicate the strength likely to be attained at 28 days.

13.2 Work Strength Tests for Controlled and Ordinary Concrete: Works strength tests shall be made in accordance with IS 516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The cubes shall be made at the rate of one set for every 50 cubic metre of concrete or a part thereof for each grade. However, if in each grade concreting done in a days less than 15 cubic metre, the number of cubes can be reduced to 6 with the specific permission of the Engineer-in Charge. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-Charge, when procedure of tests given above reveals a poor quality of concrete and in other special cases. All work shall be carried out under the supervision of a qualified and competent Engineer who will supervise proportioning, placing and compacting of concrete at all stages. All necessary labor, materials, equipment, etc. for sampling, preparing test cubes, curing, etc., shall be provided by the Contractor. Testing of materials and concrete may be arranged by the Engineer-in-Charge in an approved laboratory at the cost of the contractor.

13.3 Standard of acceptance: The strength of concrete shall conform to clause 16.0, Acceptance Criteria, as specified in IS : 456 – 2000.

13.4 Manufacture's Certification / Testing Results etc: For all materials required for concrete construction including cement, aggregate, water, reinforcing and prestressing steel the original copies of test certificates, test results etc. either carried out by the manufacturer or any other agency, the mix design recommendations etc. shall be submitted to the Engineer-in-Charge for his approval and record. It shall remain the property of the Employer.

13.5 Chloride Contents: Since the chloride contents of the constituent materials of the concrete would be additive, it is desirable to keep a check on the overall chloride content of the concrete to keep it minimal. Specially, for prestressed concrete, the total chloride content of the concrete when manufactured according to the requirements of workability and strength shall not exceed 500 ppm. by weight of cement. The costs of testing for the chloride content of the ingredients of concrete and of undertaking remedial measures if the chloride content is more than the permissible limit shall be borne by the contractor.

14.0 USE OF PLUMS IN ORDINARY / PLAIN CONCRETE

Stone plums shall not be used unless specified on the drawings. When used the size of stone plums may be from 160 to 300 mm. The maximum dimension of these stones or plums shall not exceed 1/3rd the least dimension of the members. All plums shall be hard, durable, clean and free from soft materials or loose piece or deleterious substance in them and shall not have sharp corners.

During concreting the first layer of concrete of the specified mix shall be laid to a thickness of at least two and a half times the thickness of the maximum size of plums to be used. The plums shall then be laid while the top portion of this concrete is still green but sufficiently stiff to prevent complete submergence of the plums under their own weight. These plums shall be about half embedded in the concrete and the remaining part exposed so as to form a key with the next layer of concrete. No plums shall be used for concrete laid under water.

While placing the plums, care shall be taken to see that the clear distance between any two plums is not less than either the width or thickness of either of the plums. The distance from plums to the outer surface or from any steel reinforcement shall be equal to greatest width of the plum. If plums of stratified stone are used, they shall be laid on their natural bed. Stones with concave faces shall be laid with the concave upwards. The thickness of the next and successive layers of concrete shall be at least twice that of the largest plums. The total volume of plums shall not exceed 20% of the volume of the finished concrete.

15.0 MEASUREMENT FOR PAYMENT

- The cement concrete shall be measured in cubic meters. In reinforced concrete the volume occupied by reinforcement shall not be deducted.
- Any concrete used in excess of the theoretical dimensions as shown on the drawings will not be paid for.
- Unacceptable work: All defective concreting work, including but not limited to defects arising out of honey-combing, under-sizing, under-strength, etc. are liable to be demolished and rebuilt by the Contractor at his own cost. In the event of such works being accepted by carrying out repairs etc. as specified by the Engineer-in-charge, the cost of repair will be borne by the Contractor. In the event of the works being accepted by giving a design concession arising out of but not limited to under-sizing, under-strength accepting higher than design stresses in members or accepting materials not fully meeting the specifications etc. the contractor will be paid for the work actually carried out by him at the reduced rate of 75% of the tendered rate or as decided by the Engineer-in-Charge for portion of the work thus accepted. The decision of the Engineer-in-Charge shall be final and binding.

16.0 RATE

The unit rate for concrete shall include the cost of all materials, labor, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per directions of the Engineer-in-Charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making, fixing and removing of all centres and forms required for the work unless otherwise specified in the contract.

All expenses likely to be incurred by the contractor in transporting materials supplied to him to the site of works, the expenses incurred in improving the quality of materials to acceptable levels (such as screening, washing, etc.) and expenses incurred in proper storage of materials as directed by the Engineer-in-charge etc. are to be including in the unit rate

17.0 STEEL REINFORCEMENT

17.1 BENDING OF REINFORCEMENT: Reinforcing steel shall conform accurately to the dimensions shown on relevant drawings and conforming to IS: 2502

The contractor shall make bar bending schedules, based on the drawings furnished to him and submit the same for the Engineer's approval at no extra cost. Approval by the Engineer does not relieve the contractor of his responsibility to ensure correctness in respect of details / placing. Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-Charge using a proper bar bender, operated by hand or power to attain proper radii of bends.

Bars shall not be bent or straightened in a manner that will injure the material. Bars bent during transport or handling shall be straightened before being used on work; they shall not be heated to facilitate bending. Unless otherwise specified, a U type hook at the end of each bar shall invariably be provided. The radius of the bend shall not be less than twice the diameter of the round bar for mild steel plain bars and not less than four times the diameter for high strength deformed bars. In case of bars with diameters greater than 25mm, the minimum radius should be three times the diameter for mild steel bars and six times the diameter for high strength deformed bars the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the bar. In the case of bars, which are not round, and in the case of deformed bars, the diameter shall be taken as the diameter of a circle having an equivalent effective area.

The hook shall be suitably encased to prevent any splitting of the concrete.

17.2 PLACING OF REINFORCEMENT: All reinforcing bars shall be accurately placed in the exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and conforming to IS: 280, and by using stays, blocks or metal chairs, spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation over the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal

supports will not extend to the surface of concrete, except where shown on the drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing will not be allowed. Pieces of broken stone, brick or wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast mortar blocks or other approved devices. Reinforcement after being placed in position shall be maintained in a clear condition until completely imbedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed.

To protect reinforcement from corrosion, concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout. In the case of columns and walls, vertical bars shall be kept in normal position with timber templates having slots accurately cut in for bar position. Such templates shall be removed after the concreting has progressed upto a level just below them. Bars crossing each other, where required, shall be secured by iron binding wire not less than 1 mm in size in such a manner that they do not slip over each other at the time of fixing and concreting All binding wires shall be galvanized. As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the Engineer-in-Charge. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm or 1.25 times the maximum size of the coarse aggregate in the concrete between them,, whichever is greater. Where this is not feasible, overlapping bars shall be bound with annealed steel wire, not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum. Bars of less than 3.0 M length shall not be used as main reinforcement.

17.3 WELDING OF BARS: When permitted or specified on the drawings, joints of reinforcement bars shall be butt welded so as to transmit their full strength. Welded joints shall preferably be located at points where the reinforcement steel will not be subject to more than 75 percent of the maximum permissible stresses and the welded joints should be staggered such that at any one section, not more than 33 percent of the bars are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work will be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, the previous surfaces shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work.

The M. S. Electrodes used for welding shall conform to IS: 814. Welded pieces of reinforcement shall be tested. Specimens shall be taken from the actual site and their number and the frequency of tests shall be as directed by the Engineer-in-Charge.

17.4 MEASUREMENT: Reinforcement shall be measured in length, separately for different diameters, as actually used in the work including authorized overlaps, special chairs /

separators specified in the drawings and due to limitations of available bar length. From the length so measured the weight of reinforcement shall be calculated in tonnes on the basis of standard weights specified in IS: 1732. Lengths shall also include hooks at ends. Wastage, avoidable overlaps, coupling, welded joints and annealed steel wire for binding and cover blocks shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

17.5 RATES: Rate for reinforcement shall include cost of all steel, its bending, binding and fixing in position as shown on the drawings and as directed by the Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position, cost of jointing as per approved method, and all wastage, overlaps and spacer bars etc.

18.0 FORM WORK, FALSE WORK AND SCAFFOLDING, FORM, CENTERING AND TEMPORARY WORKS

All centering, formwork and temporary works shall be constructed according to drawings and specifications prepared by the Contractor and approved by the Engineer-in-charge. The design criteria and loading for these works shall be as per American Concrete Institutes' relevant specifications.

As soon as practicable after the acceptance of his tender the contractor shall submit a scheme showing the order of the procedure and methods by which he proposes to carry out the work together with such details as are necessary to demonstrate the adequacy, stability and safety of the methods which the contractor proposes to adopt. The approval to this general scheme of centering as well as design criteria and loading shall be obtained in good time to facilitate all preparatory work. Any delay on this account shall be the responsibility of the contractor.

After approval of the general scheme the contractor will prepare detailed designs and drawings for execution of the work, centering and temporary works. These shall also be forwarded for approval. No work shall be carried out without prior approval of the Engineer-in-Charge.

Notwithstanding the approval given to design criteria and loading and the general scheme for the centering, the entire responsibility for the satisfactory execution of the centering and all temporary works shall rest with the contractor and he shall be liable to pay all claims and compensations arising from any loss or damage to life and property due to any deficiency, failure or malfunctioning of the centering or any of the temporary works.

18.1 RE-USE OF FORMS, ETC: Forms required to be used more than once shall be maintained in serviceable condition and shall be thoroughly cleaned and repaired before reuse. Where metal sheets are used for lining forms the sheets shall be placed and maintained in the forms with minimum amount of wrinkles, lumps or other imperfections. All forms shall be checked for shape and strength before reuse. Steel forms shall be cleaned by buffing before reuse.

18.2 EXECUTION & REMOVAL OF FORMS:

- Before placing concrete the surface of all forms shall be coated with suitable nonstaining form releasing agents such as raw linseed oil so as to prevent adhesion of concrete and to facilitate removal of forms.
- The form-releasing agent shall cover the forms fully and evenly without excess over drip. Care shall be taken to prevent form-releasing agents from getting on the surface of the construction joints and on reinforcement bars. Special care shall be taken to thoroughly cover form strips for narrow grooves, so as to prevent swelling of the forms and the consequent damage to concrete prior to or during removal of forms.
- Immediately before concrete is placed care shall be taken to see that all forms are in proper alignment and the supports and fixtures are properly secured and tightened.
- Where forms for continuous surfaces are placed in successive units, the forms shall lap and fit tightly over the completed surface so as to prevent leakage of cement slurry from the fresh concrete and to maintain accurate alignment of the surface
- Forms shall be left in place until their removal is authorized and shall then be removed with care so as to avoid injury to concrete.
- Removal of forms shall never be started until the concrete is thoroughly set and adequately hardened such that it can carry its own weight, besides the live load which is likely to come on the work during construction. The length of time for which the forms shall remain in place shall be decided by the Engineer-inCharge, with reference to weather conditions, shape and position of the structure or structural member and nature and amount of dead and live loads. In normal circumstances and where ordinary Portland cement is used, forms can be allowed to be struck as under:

a) Beam sides, walls, unloaded columns - after 24 hours
b) Slabs and arches (props left under) - after 4 days
c) Props to slabs and arches - after 10 days
d) Beam soffit (props left under) - after 8 days
e) Props to beams - after 21 days
f) Lean concrete (sides) - after 2 days

Note: Time shall be measured from last batch concreted in respect to the structural member under consideration.

In no case shall forms be removed until there is an assurance that removal can be accomplished without damaging the concrete surface. Heavy loads shall not be permitted until after the concrete has reached its design strength. The forms shall be removed with great caution and without jerking the structure.

18.3 SETTLEMENT OF FORMWORK & CAMBER

Due to various reasons such as closure of form joints, shrinkage of timber, dead load deflections, elastic shortening of form members or formwork, deflections, settlement may occur. The contractor shall take precautions, including using adequately rigid formwork, in order to prevent excessive settlement/deflection; the usual acceptable limit being 1/500 of the spans of the formwork.

In the absence of any specified camber on the drawings, soffit of all beams more than 5 m. in span and other than prestressed concrete beams shall be laid to a camber, the amount of which at mid span shall not be less than 1/500 of the span of the structure. The profile of soffit shall be parabolic.

19.0 TOLERANCE

All works will be carried out true to the lines, levels and grades shown on the drawings and within the tolerances specified below. The contractor shall establish, erect and maintain in an undisturbed condition until final completion and acceptance of the project control, points and benchmarks necessary and adequate to establish these tolerances.

For all elements, departure from established alignment	: 30 mm
Departure from established grades	: 10 mm
Variation from plumb or specified batter in lines and surfaces of piers, wall and abutments	: 12 mm in 3 m. if exposed :25 m in 3 m. if backfilled
Variation from level or indicated grade in slabs, beams, horizontal exposed and railing offsets	:12 mm in 3 m. if :25 mm in 3 m. if backfilled.
Variation in cross sectional dimensions of columns, piers, slabs, walls, beams and similar parts	:-6 mm, + 12 mm

Variation in slab thickness	-3 mm, + 6 mm
Footings: Plan dimensions	-15 mm, + 30 mm
Misplacement or eccentricity	: 2% of footing width in the direction of misplacement and not exceeding 30mm.
Reduction in thickness	: 5% of specified thickness
Variations in size and locations	

of slab or wall openings	12 mm

Prestressed concrete cables - will be laid such that their profile is a smooth curve unless otherwise specified.

The alignment tolerances shall be as under:

Member with a depth of upto	Tolerance in direction of depth 'd' of members.
Upto 200 mm	+d/40
200 - 1000 mm	+ 5 mm
more than 1000 mm	+ 10 mm

Tolerance in direction of width of member @ the level of tendon.	
Upto 200 mm wide	+5 mm
200 - 1000 mm wide	+10 mm
Slabs and beams of more than 1000 mm wide	+20 mm

Tendon extensions will be measured upto 1 mm accuracy. The total prestressing force applied to a beam shall not vary more than + 3% from the design force specified and **measured** in terms of the total elongation of all the tendons in that member.

In the case of slabs this variation shall be measured and restricted over a range of 5 consecutive tendons.

20.0 VACCUM DEWATERING

The RCC/PCC in slabs & floors should be vacuum dewatered if directed by the Engineer-In-Charge, using vacuum dewatering system consisting of vibrating screed, filter pads, suction mat, skim floater cum troweler with necessary safety mechanism etc. as per manufacturer's specification.

21.0 READY-MIXED CONCRETE

Ready-mixed concrete is concrete supplied by an independent vendor having a Readymixed plant outside the site. All specifications for plain, reinforced & pre-stressed concrete shall be applicable to this section of Ready-mixed concrete also.

21.1 READY MIX CONCRETE SUPPLIER: The Contractor shall identify a supplier in such a manner that concrete is available at site without hindrance and quality is maintained during concreting. Due attention shall be paid to the quality of Plant and Machinery, laboratory facilities available with the supplier, proper documentation procedures maintained by the supplier and trained, qualified staff shall be employed by the supplier. Consideration shall also be given to distance of plant from site, quality of transporting equipments and documentation procedures maintained by the supplier related to transport. After identifying Ready-mixed Concrete supplier the contractors must submit necessary documentation as indicated above to the Engineer for his approval. The Ready mixed concrete manufacturer / supplier will be an approved specialist agency as per method of working approved by the Engineer.

21.2 DOCUMENT TO BE SUBMITTED & MAINTAINED BY THE CONTRACTOR DURING CONSTRUCTION: Mix design used for concrete should include type and quality of cement, admixture, aggregates, water, etc. including test results for all materials. The document shall also include laboratory tests carried out for confirmation of workability, strength, setting time, etc.

Quality Control / Assurance certificate from the manufacturer / supplier of the ready mixed concrete indicating the type and quantity of each component of concrete shall be submitted for each batch of concrete. The document shall also indicate the date and time of concrete and 'use before' time. Documentation for ons ite tests carried out during concreting. Results of Cube tests and other laboratory tests carried out by the supplier in the plant.

21.3 TRANSPORTING OF READY-MIX CONCRETE: Before loading concrete in the transit mixer, the container shall be thoroughly cleaned, washed and kept moist. Method of transportation used shall ensure efficient delivery and no significant alterations of properties of concrete such as water-cement ratio, slump, air content, homogeneity, etc.

21.4 PLACING OF READY-MIX CONCRETE: The batching plant operator and the placing crew at site shall work in close co-ordination to avoid any delay in despatching the concrete as well as to stop despatch if the work at site is not ready for concrete work. Proper record of order, delivery and placement of concrete shall be maintained by the contractor on site and submitted to the Engineer-In- Charge who shall have direct access to the batching plant to control all the activities in the production and placement of concrete.

21.5 TEMPERATURE: Temperature of concrete at the time of delivery shall be in accordance with IS 4926 (1976) or any other agreed standard.

21.6 DELIVERY TIME: The time period between the initial contact of mixing water with cement and delivery to the contractor shall not generally exceed two hours. This figure is a general one and can be reduced or extended depending upon mix design, ambient temperature and the

design criteria of the structure.

21.7 ADDITION OF WATER: Unless otherwise agreed no additional water shall be added to the concrete after the transit mixer has left the production plant. The contractor is responsible for the prevention of any additional water added to the concrete on site. The only exception is where properly trained Ready-mixed concrete supplier personnel adjust the workability to comply with the specified slump requirement without exceeding either the specified maximum free water cement ratio or slump tolerances. It is suggested that this is performed by using a calibrated water meter. The quantity of additional water shall be recorded on the delivery ticket and signed by the Ready-mixed concrete supplier's representative Performance of such concrete shall be ascertained through normal testing practices.

STRUCTURAL STEEL WORK

CONTENTS

1.0 SCOPE

This specification covers Preparation of fabrication drawings, Providing all materials, fabricating, transporting, erection in position to proper lines and levels, fixing, steelwork for various structures and painting / other protection of steelwork for structures including fixtures, fittings, temporary works and supports, and ancillaries. The steelwork may have to be fabricated out of steel shapes, plates, hollow sections, pipes, cast steel, forgings etc and may involve any or combination of two or more of these in sizes, quantity and quality as specified in the drawings or as directed by the Engineer. The steelwork may consist of all types such as columns, beams, trusses, wall beams, girders, brackets, base-plates, floorings, anchors, stairs bracings or of any other kind as shown in the drawings or as required by the Engineer. Painting would involve cleaning as given and painting with various combinations of primary and intermediate and final coats of specified thickness.

The Contractor shall furnish all the materials, skilled staff and labour, transportation, equipment, tools, tackles, temporary work and all other things that may be required for carrying out the work described above as per drawings, specifications and the instructions of the Engineer

1.1 CODES & STANDARDS

Codes and standards applicable are given in the list below, which however shall not limit the applicable standards or codes or directions of the Engineer.

Table – Codes of Practice and Standards

Specification	***Description***
IS: 800 IS: 808	Code of practice for general construction in steel Dimensions of hot rolled steel beam, column channel and angle sections
IS: 813	Scheme of symbols for welding
IS: 814	Covered electrodes for manual metal arc welding of Carbon and carbon-manganese steel
IS: 816	Code of practice for use of metal arc welding in general mild steel construction
IS: 817	Code of practice for training and testing of metal arc welders
IS: 818	Code of Practice for safety and health requirements in electric and gas welding and cutting operations
IS: 822	Code of procedure for inspection of welds
IS: 823	Code of procedure for manual metal arc welding of mild steel
IS: 1030	Carbon Steel castings for general engineering purposes

IS: 1161	Steel tubes for structural purposes
IS: 1181	Qualifying tests for metal arc welders
IS: 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
IS: 1363 (1&2)	Hexagon head bolts and nuts of product grade C
IS: 1364 (1-5)	Hexagon head bolts and nuts of product grade A and B
IS: 1367 (1-20)	Technical supply conditions for threaded steel fasteners
Specification	Description
IS: 1387	General requirements for the supply of metallurgical materials
IS: 1477 (1 & 2)	Code of Practice for painting ferrous metals in buildings
IS: 1599	Method for bent test
IS: 1608	Mechanical testing of metals – tensile testing
IS: 1730	Steel plates, sheets and strips and flats for general engineering purposes – dimensions
IS: 1852	Rolling and cutting tolerances for hot rolled steel products
IS: 2004	Carbon Steel forgings for general engineering purposes
IS: 2016	Plain washers
IS: 2062	Steel for general structural purposes – (supersedes IS: 226)
IS: 2595	Code or practice for radiographic testing
IS: 3502	Steel chequered plates
IS: 3613	Acceptance test for wire flux combination for submerged arc welding
IS: 3640	Hexagon fit bolts
IS: 3658	Code of practice for liquid penetrant flaw detection
IS: 3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS: 3696	Safety codes for scaffolds and ladders
IS: 3757	High strength structural bolts

IS: 4353	Submerged arc welding of mild steel and low alloy steels – recommendations
IS: 4923	Hollow steel sections for structural use
IS: 5334	Code of practice for magnetic particle flaw detection of welds
IS: 5372	Taper washers for channel
IS: 5624	Foundation bolts
Specification	***Description***
IS: 6610	Heavy washers for steel structures
IS: 6639	Hexagon bolts for steel structures
IS: 7205	Safety code for erection of structural steelwork
IS: 7215	Tolerances for fabrication of steel structures
IS: 7293	Safety code for working with construction machinery
IS: 9595	Metal arc welding of carbon and carbon manganese steels – recommendations
IS: 12843	Tolerances for erection of steel structures
SP: 34	Handbook of concrete reinforcement and detailing

2.0 INSPECTION OF SITE

It is presumed that the site has been inspected and all site conditions noted that might affect the selection of erection method, plant requirements and such details. The method and units of transportation of structures from fabrication yards to site would also depend on the location of fabrication yards, the dimensions and grades of the connecting roads and the approach to the erection location. It is necessary that during the work the existing structures (where there are some) are not damaged or affected anyway by the present work.

3.0 STRUCTURAL STEEL

3.1 GENERAL

General requirements relating to the supply of material shall conform to the specifications of IS: 1387, for the purpose of which the supplier shall be the Contractor and the purchaser shall be the Engineer.

Finished rolled material shall be free from cracks, flaws, injurious seams, laps, blisters, ragged and imperfect edges and other defects. It shall have a smooth and uniform finish, and shall be straightened in the mill before shipment. They shall also be free from loose mill scale, rust, pits or other defects affecting its strength and durability.

The acceptance of any material on inspection at the mill i.e. rolling mills, foundry or fabricating plant where material for the work is manufactured, shall not be a bar to its subsequent rejection, if found defective.

4.0 OTHER MATERIALS

4.1 All materials shall conform to Special requirements as given below:

4.2 Mild steel for bolts and nuts shall conform to IS: 2062 but have a minimum tensile strength of 44 kg/sq. mm. and minimum percentage elongation of 14. High tensile steel for bolts and nuts shall conform to IS: 8500 but with a minimum tensile strength of 58 kg/sq. mm.

4.3 For cast steel, the yield stress shall be determined and shall not be less than 50 percent of the minimum tensile strength.

4.4 Plain washers shall be of steel. Tapered or other specially shaped washers shall be of steel or malleable cast iron.

4.5 Parallel barrel drifts shall have a tensile strength not less than 55 kg/sq. mm, with elongation of not less than 20 percent measured on a gauge length of 4 So (So = cross sectional area).

4.6 Materials for castings and forgings, fasteners and welding consumables shall be as under:

Castings and Forgings: Steel castings and forgings shall comply with the requirements of the following Indian Standards, as appropriate:

IS: 1030 Carbon Steel Castings for General Engineering purposes IS:
1875 Carbon Steel Billets, blooms, slabs, bars for forgings
IS: 2004 Carbon Steel Forgings for General Engineer purposes IS:
2644 High Tensile Steel Casings
IS: 4367 Alloy & tool steel forgings for general industrial use

5.0 STEEL PROTECTION SYSTEM

Generally all steelwork shall be cleaned as indicated or sand / shot blasted to SA – 2-1/2 (SIS 055900) if mentioned specifically in the schedule of quantities and given the following coats of paint.

- One coat of zinc anode epoxy primer (or equivalent of similar properties) with a minimum dry film thickness of 75 microns per coat
- An intermediate coat of epilux 950 super high build coating (or equivalent of similar properties) with a dry film thickness of 200 microns
- Two coats of acrylic polyurethane enamel minimum dry film thickness of 30/35 microns per coat

Unless otherwise specified, paints shall conform to the relevant IS specifications. The paints that have been tested as per specifications only shall be used. Where there are no specifications, manufacturer's recommendation shall be followed.

6.0 FABRICATION

6.1 GENERAL

All work shall be in accordance with the drawings approved and released by the Engineer for construction, as per these specifications and as instructed by the Engineer. Care should be exercised by the Contractor to ensure that all parts of an assembly are so well fabricated to fit accurately together. All members shall carry a mark number and an item number and, if required, serial no.

Unless specifically required under the contract, corresponding parts for identical units need not be interchangeable, but the parts shall be match marked. Templates and other appliances used for ensuring the accuracy of the work shall be of mild steel. All measurements for fabrication shall be made by means of accurate steel tapes or other devices properly calibrated.

All structural steel members and parts shall have straight edges and blunt surfaces. If necessary they shall be straightened or flattened by pressure unless they are required to be of curvilinear forms. They shall also be free from twist. Pressure applied for straightening or flattening shall be such that would not injure the materials. Hammering shall not be permitted. Adjacent surface or edges shall be in close contact or at uniform distance throughout.

The contractor shall submit his program of work to the Engineer for his approval at least 15 days before commencement of fabrication. This program shall include the proposed system of identification and erection marks together with complete details of fabrication and welding procedures.

The Contractor shall prepare shop drawings for fabricating the components of steelwork and obtain approval of the Engineer a week before the start of work on the components. Complete information regarding the location, type, size and extent of all welds shall be clearly shown on the shop drawings. The drawings shall distinguish between shop and field welds

6.2 PREPARATION OF EDGES & ENDS

All structural steel parts, where required, shall be sheared, cropped, sawn or flame cut and ground accurately to the required dimension and shape. End/edge planning and cutting shall be done by any one of the following prescribed methods or left as rolled: a) Shearing, cropping, sawing, machining, machine flame cutting.

b) Hand flame cutting with subsequent grinding to a smooth edge.

c) Sheared edges of plate not more than 16mm thick with subsequent grinding to smooth profile, which are of secondary use such as stiffeners and gussets.

If the ends of stiffeners are required to be fitted, they shall be ground, so that the maximum gap over 60% of the contact area does not exceed 0.25 mm.

Where the flame cutting or shearing is used, at least one of the following requirements shall be satisfied.

a) The cut edge is not subject to applied stress.
b) The edge is incorporated in weld.
c) The hardness of cut edge does not exceed 350 HV 30.
d) The material is removed from the edge to the extent of 2 mm or minimum necessary, so that the hardness is less than 350 HV 30.
e) Edge is suitably heat treated by approved method to the satisfaction of the Engineer and shown that crack had not developed by dye penetrant or magnetic particle test.
f) Thickness of plate is less than 40 mm for machine flame cutting for materials conforming to IS: 2062. The requirement of hardness below 350 HV 30 of flame cut edges should be specified by the Engineer.

Where machining for edge preparation in butt joint is specified, the end shall be machined after the members have been fabricated. Outside edges of plate and section, which are prone to corrosion shall be smoothed by grinding or filing. In the case of high tensile steel at least 6 mm of the material from the flame cut edge shall be removed by machining. Longitudinal edges of all plate and cover plates in plate girders and built-up members shall be ground to correct dimensions except in the following cases:

a) Covers to single flange plates may be left un-machined.
b) Machine flame cutting instead of machining is acceptable for edges of single plates, 25 mm or less thick, in tension.
c) Edges of single shaped plates over 25 mm thick may be machine flame cut and the end surface ground.
d) Edges of plates or flats of the same nominal width in tiers may be left un machined, if so authorized by the Engineer.

All edges of splice and gusset plates may be sheared and ground. The ends of plates and sections forming the main components of plate girders or of built-up members may be machine flame cut, sawn or hand flame cut and ground. Where ends of stiffeners are required to be fitted, they shall be machined, machine flame cut, swan, sheared and ground, or hand flame cut and ground. The ends of lacing bar shall be rounded unless otherwise required. Other edges and ends of mild steel parts may be sheared and any burrs at edges shall be removed.

6.3 PREPARATION OF HOLES

6.3.1 Drilling and Punching: Holes for black bolts, high strength bolts and counter sunk bolts (excluding close tolerance and turn fitted bolts) shall be either punched or drilled. The diameter of holes shall be 1.5 mm larger for bolts less than 25 m. dia and 2.0 mm for more than or equal to 25 mm. All the holes shall be drilled except for secondary members such as, floor plate, handrails etc. Members which do not carry the main load can be punched subject to the thickness of member not exceeding 12 mm for material conforming to IS: 226.

Holes through one thickness of material or when any of the thickness exceeds 20 mm for steel conforming to IS: 2062 or 16 mm for conforming to IS: 8500, shall either be subdrilled or sub-punched to a diameter of 3 mm less than the required size and then reamed to the required size. The reaming of material more than one thickness shall be done after assembly.

Where several plates or sections form a compound member, they shall where practicable, be firmly connected together by clamps or tacking bolts, and the holes be drilled through the group in one operation. Alternatively, and in the case of repetition work, the plates and sections may be drilled separately from templates that shall be checked periodically.

All burrs shall be removed.

Shop erection / assembly shall be done wherever so required by the engineer.

6.3.2 Where block drilling is done, care shall be taken to check that the holes are not out of position or are dimensionally correct.

6.3.3 Size of Holes: The sizes of holes in millimeters are given in table 1 below:

SL NO	NOMINAL DIA OF BOLTS IN MM	DIA OF HOLES IN MM	SL NO	NOMINAL DIA OF BOLTS IN MM	DIA OF HOLES IN MM
1	12	13.5	6	24	25.5
2	14	15.5	7	27	29.0
3	16	17.5	8	30	31.0
4	18	19.5	9	31	33.0
5	20	21.5	10		

6.3.4 Close tolerance bolts and barrel bolts**:** Holes for close tolerance and turn fitted bolts. The diameter of the holes shall be equal to the nominal diameter of the bolt shank minus 0.15 mm to 0.0 mm.

The member to be connected with close tolerance or turn fitted bolts shall be firmly held together by service bolts or clamped and drilled through all thickness in one operation and subsequently reamed to required size within specified limit of accuracy as specified in IS: 919 tolerance grade H8.

The holes not drilled through all thickness at one operation shall be drilled to smaller size and reamed after assembly**.**

6.3.5 Holes for high strength friction grip bolts: All holes shall be drilled after removal of burrs**.** Where the number of plies in the grip does not exceed three, the diameters of holes shall be 1.6 mm larger than those of bolts and for more than three plies in grip, the diameter of hole in outer plies shall be as above and dia of holes in inner plies shall not be less than 1.6 mm and not more than 3.2 mm larger than those in bolts, unless otherwise specified by the Engineer.

6.3.6 Removal of Burrs**:** The work shall be taken apart after drilling and all burs left by drilling and the sharp edges of all rivet holes completely removed.

7.0 BOLTS, NUTS AND WASHERS

7.1 Black bolts (black all over): Black bolts are forged bolts in which the shanks, heads and nuts do not receive any further treatment except cutting of screw threads. They shall be true to shape and size and shall have the standard dimensions as shown on the drawings.

7.2 Close tolerance bolts: Close tolerance bolts shall be faced under the head and turned on the shank.

7.3 Turned barrel bolts: The diameter of the screwed portion of turned barrel bolts shall be 1.5 mm smaller than the diameter of the barrel unless otherwise specified by the Engineer. The diameter of the bolts as given on the drawing shall be the nominal diameter of the barrel. The length of the barrel shall be such that it bears fully on all the parts connected. The threaded portion of each bolt shall project through the nut by at least one thread. Faces of heads and nuts bearing on steel work shall be machined.

7.4 Washers: In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a steel washer under the nut of sufficient thickness of the parts bolted together and to prevent the nut when screwed up, from bearing of the bolt. For close tolerance or turned barrel bolts, steel washers whose faces give a true bearing shall be provided under the nut. The washer shall have a whole diameter not less than 1.5 mm larger than the barrel and a thickness of not less than 6 mm so that the nut when screwed up will not bear on the shoulder of the bolt.

Taper washers with correct angle of taper shall be provided under all heads and nuts bearing on beveled surfaces. Spring washers may be used under nuts to prevent slackening of the nuts when excessive vibrations occur.

Where the heads or nuts bear on timber, square washers having a length of each side not less than three times the diameter of bolts or round washers having a diameter of 3½ times the diameter of bolts and with a thickness not less than one quarter of diameter shall be provided.

7.5 Studs: Ordinary studs may be used for holding parts together, the holes in one of the parts being tapped to take the thread of the stud. Counter-sunk studs may be used for making the connections where the surfaces are required to be cleared of all obstruction, such as protruding heads of bolts, studs may also be welded on the steel work in the positions required.

7.6 Service bolts: Service bolts shall have the same clearance as black bolts and where it is required that there should be no movement prior to final riveting, sufficient drifts or close tolerance bolts shall be used to locate the work.

7.7 Tightening bolts: Bolted connection joints with black bolts and high strength bolts shall be inspected for compliance of Code requirements.

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

The tightness of bolts in connection shall be checked by inspection wrench, which can be torque wrench, power wrench or calibrated wrench.

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

7.8 Drifts-The barrel shall be drawn or machined to the required diameter for a length of not less than one diameter over the combined thickness of the metal through which the drifts have to pass. The diameter of the parallel barrel shall be equal to the nominal diameter of the hole subject to a tolerance of +0 mm and –0.125 mm. Both ends of the drift for a length equal to 1½ times the diameter of the parallel portion of the bar shall be turned down with a taper to a diameter at the end equal to one-half that of parallel portion.

7.9 Pin and pin holes

7.9.1 Pins : The pins shall be parallel throughout and shall have a smooth surface free from flaws. They shall be of sufficient length to ensure that all parts connected thereby shall have a full bearing on them. Where the ends are threaded, they shall be turned to a smaller diameter at the ends for the thread and shall be provided with a pilot nut, where necessary, to protect the thread when being drawn to place. Where the ends are not threaded suitable cotter arrangements shall be made to prevent pin from working loose.

Pins more than 175 mm in length or diameter shall be forged and annealed.

7.9.2 Pinholes: Pinholes shall be bored true to gauge, smooth, straight at right angles to the axis of the member and parallel with each other, unless otherwise required. The tolerance in the length of tension members from outside to outside of pinholes and of compression members from inside to inside of pinholes shall be as specified in the drawings. In built up members, the boring shall be done after the members have been riveted or welded. Where specified proper brass / gunmetal bushes shall be provided in the pinholes.

The specified diameter of the pinhole shall be its minimum diameter. The resulting clearance between the pin and the hole shall be not less than 0.5 mm and not more than 1.0 mm or otherwise as specified in the drawings.

8.0 SHOP ERECTION AND MATCH MARKING

Sub-sections of the steelwork, if so required by the Engineer, shall be temporarily erected in the fabrication shop before dispatch to site, for the Engineer's inspection. The quality of fabrication, and the alignment and fit of all connections would be checked. For this purpose a sufficient number of parallel drifts and service bolts that tightly screw up, shall be employed. All parts shall fit accurately and be in accordance with drawings and specifications. After the Engineer's approval, any sub-size holes left shall be reamed to size and materials match marked and dispatched to site. The Engineer shall be the sole authority to decide the extent of shop erection required.

After the work has been approved by the Engineer and before it is dismantled, each part shall be carefully marked for erection with distinguished marks and stamped with durable markings. Drawings showing these markings correctly shall be supplied to the Engineer.

Unloading, handling and storage of steel work as per these specifications shall be the responsibility of the Contractor. The cost of repairs or rejected material, its removal and the cost of transporting replacement material to the site shall be borne by the Contractor.

9.0 WELDING

All welding shall be done with prior approval of the Engineer and the workmanship shall conform to the specifications of IS: 823 or other relevant Indian Standards as appropriate.

When material thickness is 20 mm or more, special precaution like preheating shall be taken as laid down in IS: 823. Surfaces and edges to be welded shall be welded smooth, uniform and free from fins, tears, cracks and other discontinuities. Surfaces shall also be free from loose or thick scale, slug rust, moisture, oil and other foreign materials. Surfaces within 50 mm of any weld location shall be free from any paint or other material that may prevent proper welding or cause objectionable fumes during welding. The general welding procedures including particulars of the preparation of fusion faces for metal arc welding shall be carried out in accordance with IS: 9595.

The welding procedures for shop and site welds including edge preparation of fusion faces shall be submitted in writing in accordance with Clause 22 of IS: 9595 for the approval of the Engineer before commencing fabrication and shall also be as per details shown on the drawings. Any deviation from above has to be approved by the Engineer. Preparation of edges shall, wherever practicable done by machine methods.

Machine flame cut edges shall be substantially as smooth and regular as those produced by edge planning and shall be left free of slag. The Engineer shall permit manual flame cutting only where machine cutting is not practicable.

Electrodes to be used for metal arc welding shall comply with relevant IS specifications. Test shall be carried forward as per IS: 8613 to find out suitable wire flux combination for welded joint.

Assembly of parts for welding shall be in accordance with provisions of IS: 9595.

The welded temporary attachments should be avoided as far as possible, otherwise the method of making any temporary attachments shall be removed by cutting, and chipping and surface shall be finished smooth by grinding to the satisfaction of the Engineer.

Welding shall not be done when the air temperature is less than 10 degrees Celsius.

Welding shall not be done when the surfaces are moist, during periods of strong winds or snowy weather unless the work and the welding operators are adequately protected.

For welding of any particular type of joint, welders shall qualify to the satisfaction of the Engineer in accordance with appropriate welders qualification tests as prescribed in any of the Indian Standards IS: 817, IS: 1393, IS: 7307(PART I), IS: 7310(PART I) and IS: 7318 (PART I) as relevant.

In assembling and joining parts of a structure or of built up members, the procedure and sequence of welding shall be such as to avoid distortion and minimise shrinkage stress. All requirements regarding pre heating of parent material and interpass temperature shall be in accordance with provision of IS: 9595

Peening of weld shall be carried out wherever specified by the Engineer:

a) If specified peening may be employed to be effective on each weld layer except first.

b) The peening shall be carried out after weld has cooled out by light blows from a power hammer using a round nose tool. Care shall be taken to prevent scaling or flaking of weld and base metal from over penning.

Where the Engineer has specified the butt welds are to be ground flush, the loss of parent metal shall not be greater than that allowed for minor surface defects. The end of butt joints shall be welded so as to provide full throat thickness. This may be done by use of extension pieces, cross runs or other means approved by the Engineer. Extension pieces shall be removed after the joint has cooled and the ends of the welds shall be finished smooth and flush with the faces of the abutting parts.

The joints and welds listed below are prohibited type, which do not perform well under cyclic loading.

a) Butt joints not fully welded throughout their cross section
b) Groove welds made from one side only without any backing grip
c) Intermittent groove welds
d) Bevel grooves and J grooves in butt joints for other than horizontal position
e) Plug and slot welds

The run on and run off plate extension shall be used providing full throat thickness at the end of butt-welded joints. These plates shall comply with the following requirements.

i) One pair of run on and one pair of run off plates prepared from same thickness and profile as the parent metal shall be attached to start and finish of all butt welds preferably by clamps.

ii) When run on and run off plates shall be removed by flame cutting, it should be cut at more than 3 mm from parent metal and remaining metal shall be removed by grinding or by any other method approved by the Engineer.

10.0 TOLERANCES

The tolerances in fabrications shall be governed by IS: 7215. Tolerances in dimensions of components of fabricated structural steel work shall be specified on the drawings and shall be subject to the approval of the Engineer before fabrication. Unless specified all parts of an assembly shall fit together accurately within tolerances specified in Table –2. A machine bearing surface, where specified by the Engineer, shall be machined with a deviation of 0.25mm for surfaces that can be inscribed within a square of side 0.5 m.

TABLE -2 FABRICATION TOLERANCES

SL NO	DESCRIPTION OW ITEMS	TOLERANCES
1	LENGTH	
	a) Member with both ends finished for contact bearing	± 1mm

	b) individual components of members with end plate connection	+ 0 mm, -2 mm
	c) Other members i) up to and including 12 m	± 2 mm
	Other members ii) over 12 m	± 3.5 mm
2	WIDTH	
	a) width of built-up girders	± 3 mm
	b) Deviation in the width of members required to be inserted in other members	+ 0 mm - 3 mm
3	DEPTH	
	Deviation in the depth of the solid web and open web girder	+3 mm, -2 mm
4	STRAIGHTNESS	
	a) Deviation from straightness of columns (L – length of member)	L/3000 with max of 15 mm
	i) in elevation	+5 mm, - 0 mm
	ii) in plan	L/1000 with max. of 10 mm
5	Deviation of centre line of web from centre line of flanges in built up members at contact surfaces	3mm
6	Deviation from flatness of plate of webs of built members in a length equal to depth of member (d- depth of member)	0.005 d with a max of 2 mm
7	Tilt of flange of plate girders (b – width of the member)	
	i) At splices and stiffeners, at supports, at the top flanges of plate girders and at bearings	0.005 b with a max of 2 mm
	ii) at other places	0.015 b with a max of 4 mm
8	Deviation from square ness of the flange to web of columns and box girders (L is nominal length of the diagonal)	L/1000
9	Deviation from squareness of fixed base plate (not machined) to axis of column. This dimension shall be measured parallel to the longitudinal axis of the column at points where the outer surfaces of the column sections make contact with the base plate (D- the distance from the column axis to the point under consideration on the base plate)	D/500
10	Deviation from square ness of machined ends to axes of columns (D- same as in 9 above)	D/1000
11	Deviation from square ness of machined ends to axes of beams of girder (D- same as in 9 above)	D/1000
12	Ends of member abutting at joints through cleats or end plates, permissible deviation from the square ness of ends	1/600 of depth of member subject to a max of 1.5 mm

11.0 PACKING AND TRANSPORT

All projecting plates and bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers and small loose parts shall be packed separately in cases, so as to prevent damage or distortion. Care shall be taken during loading and unloading so that no material sustains damage and materials are not mixed up.

The materials shall be carefully transported and unloaded at site of erection, exercising great care not to damage the materials in any manner. They shall be stored as per erection marks and sizes with small materials being stored in sheds to prevent loss or mixing up.

12.0 ERECTION

12.1 GENERAL

The provisions of this item shall apply of erection of steelwork in the various structures either in the roof or elsewhere.

The contractor shall transport the fabricated steel to the erection site. This should be done without damaging the steelwork in any manner. Even so the steelwork shall be subject to the Engineer's inspection and minor rectification if needed shall be carried out as directed by the Engineer. The steelwork shall be erected in position to lines and levels as shown in the drawings with or without enabling works. It will be welded or bolted in final position all as shown in the drawings. The contractor shall take all safety precautions to prevent any damage to the work or any accident. After erection and necessary welding / bolting is approved by the Engineer, the Contractor shall touch up the shop paints as necessary and shall apply the required coats of paint as shown in the drawings. After approval of painting, further work on the structure such as sheeting etc shall be carried and do all the work required to complete the construction included in the contract in accordance with the drawings and the specification and to the entire satisfaction of the Engineer.

12.2 ORGANIZATION AND EQUIPMENT

The contractor shall submit a complete erection scheme for the approval of the Engineer showing the equipment that he would be a method and procedure of erection, compatible with details of fabrication. As time is of the very essence, the means to achieve fast and accurate work shall be employed. The approval of the Engineer shall not relieve the contractor of his responsibility for the safety of his method or equipment or from carrying out the work fully in accordance with the drawings of the specifications.

A detailed scheme must be prepared showing stage-wise activities, with complete drawings and phase-wise working instructions. This should be based on detailed stagewise calculation and take into account specifications and capacity of erection machinery, tools, tackles to be used and temporary working loads as per Code provisions. Temporary work where used shall be supported by design and calculations.

The scheme should be based on site conditions, erection machinery employed, available working space, length and weight of members to be handled. The accent of the scheme shall be safe working and avoidance of any risk of accident.

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

Unless otherwise provided in the contract, the contractor shall supply and erect all necessary false work and staging and shall supply all labour, tools, erection plant and other materials necessary to carry out the work complete in all aspects.

The contractor shall supply all types, bolts, nuts, washers, etc. required to complete erection at site with allowance for wastage, etc., of 10% of the net number of field bolts, washers required, or a minimum of five number of each item.

Service bolts and nuts, ordinary plate washers and drifts for use in the erection of works shall be supplied at 25% of the number of the permanent bolts in the work.

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

For welded structure, welders' qualifications and skill are to be checked as per standard norms.

Safety requirements should conform to IS: 7205, IS: 7273 and IS: 7269 as applicable. Safety shall be the paramount consideration in erection work.

Erection work should start with complete resources mobilised as per latest approved drawings and after a thorough survey of foundations and other related structural work. The structure should be divided into erectable modules as per the scheme. This should be preassembled in a suitable yard/platform and its matching with members of the adjacent module checked by trial assembly before erection.

The structure shall be set out to the required lines and levels. The steelwork should be erected, adjusted and completed in the required position to the specified line and levels with sufficient drifts and bolts. Packing materials are to be available to maintain this condition. Organised "Quality Surveillance" checks need to be exercised frequently.

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

12.3 HANDLING AND STORING MATERIALS

Suitable area for storage of structures and components shall be located near the site of work. The access road should be free from water logging during the working period and the storage area should be on leveled and firm ground. The store should be provided with adequate handling equipment's e.g. road mobile crane, gantries, derricks, chain pulley blocks, winch of capacity as required. Stacking area should be planned and have racks, stands sleeper, access tracks, etc., and properly lighted.

Storage should be planned to suit work sequence and avoid damage or distortion. Rusted, bent or damaged steel shall be rejected. Methods of storage and handling steel, whether fabricated or not shall be subject to the approval of Engineer and should be accessible to handling equipment.

Small fitting hand tools are to be kept in containers in covered stores. All materials, consumables, including raw steel or fabricated material shall be stored specification-wise and size-wise above the ground upon platforms, skids or other supports.

It shall be kept free from dirt and other foreign matter and shall be protected as far as possible from corrosion and distortion. The electrodes shall be stored specification-wise and shall be kept in dry warm condition in properly designed racks. The bolts, nuts, washers and other fasteners shall be stored on racks above the ground with protective oil coating in gunny bags and suitably marked. It is essential to ensure that bolts of different strengths / sizes are not mixed up. The paint shall be stored under cover in airtight containers.

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

12.4 STRAIGHTENING BENT MATERIAL

The straightening of plates, angles and other shapes shall be done with prior approval of the Engineer by methods not likely to produce fracture or any injury. The metal shall not be heated unless permitted by the Engineer for special cases, when the heating shall not be to a temperature higher than that producing a dark "cherry red" colour, followed by as slow cooling as possible.

Following the straightening of a bend or buckle the surface shall be carefully investigated for evidence of fracture. Sharp kinks and bends may be the cause for rejection of material.

12.5 ASSEMBLING STEEL

The parts shall be accurately assembled as shown on the drawings and match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged.

Hammering which will injure or distort the members shall not be done. Bearing surface or surfaces to be in permanent contact shall be cleaned, given a coat of contact paint before the members are assembled.

All joint surfaces for bolted connections including bolts, nuts, washers shall be free from scale, dirt, burrs, other foreign materials and defects that would prevent solid seating of parts. The slope of surface of bolted parts in contact with bolt head and nut shall not exceed 1 in 20, plane normal to bolt axis, otherwise suitable tapered washer shall be used. All fasteners shall have a washer under nut or bolt head whichever is turned in tightening. Any connection to be bolted shall be secured in close contact with service bolts or before the connections are finally bolted. Joints shall normally be made by filling not less than 50 percent of holes with service bolts and barrel drifts in the ratio 4:1. The service bolts are to be fully tightened up as soon as the joint is assembled. Connections to be made by close tolerance or barrel bolts shall be completed as soon as practicable after assembly. Any Connection to be site welded shall be securely held in position by approved methods to ensure accurate alignment, camber and elevation before welding is commenced. The field welding, bolted and pin connection shall conform to the Code requirements. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents proper assembling and fitting up of parts by moderate use of drifts or by a moderate amount of reaming and slight chipping or cutting shall be reported immediately to the Engineer and his approval of the method of correction obtained. The correction shall be made in the presence of the Engineer.

12.6 ERECTION TOLERANCE

The unloaded steel structure, as erected shall satisfy the criteria specified in the following table within specified tolerance limits. Each criterion given in the table shall be considered as a separate requirement, to be satisfied independently of any other tolerance criterion. The erection tolerances specified in the table apply to the following reference points:

For a column, the actual centre point of the column at each floor level and at the base, excluding any base-plate or cap-plate. The level of the base plate on pedestal shall be so as to avoid contact with the soil and corrosion environment.

For a beam the actual centre point of the top surface at each end of the beam, excluding any end plate.

Permissible tolerances after erection

Criterion	**Criterion Permitted deviation**
Deviation of distance between adjacent columns	5 mm
Inclination of a column in a multistory building between adjacent floor levels	0.002 h where h is the storey height
Deviation of location of a column in a multi-storey building at any floor level from a vertical line through the intended location of the column base	.0035 . hb / n 0.5 where . hb is the total height from the base to the floor level concerned and n is the number of storeys from the base to the floor level concerned

Inclination of a column in a single storey building, (not supporting a crane gantry) other than a portal frame	0.0035 h c where h c is the height of the column
Inclination of the column of a portal frame (not supporting a crane gantry)	Mean 0.002 h c Individual 0.010 h c Where h c is the height of the column

A tension member shall not deviate from its correct position relative to the members to which it is connected by more than 3 mm along any setting axis.

12.7 SETTING COLUMN BASES AND GROUTING

Column bases shall be set so that the column load is uniformly transmitted to the foundation with column centre line aligned with the foundation as shown in the drawings. The location and layout of anchor bolts are to be correctly set to ensure that the structures are erected as shown in the drawings.

The Contractor shall be responsible for the correct alignment and leveling of all teelwork at site to ensure that the columns are plumb.

Before erection of columns on foundations, the top surface of the base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose material. The Contractor shall be responsible to provide all packing and shim plates that may be required for the proper erection and bedding of the columns with base plates. No steel structure shall be erected on the foundation unless the foundation has been certified fit for erection of steel, by the Engineer. Adequate number of air releases and inspection holes shall be provided in the base plate.

After the column is erected and alignment is checked and accepted, the column with base shall be held firmly in position by shims and pickings. The space between the column base and the base concrete shall be grouted with approved non-shrink grout. The substrate surface must be free of contaminants and all dirt and dust blown clean. The surface shall be thoroughly cleaned with water and all free water removed after cleaning. A containing formwork or other arrangement shall be made to hold the grout without leaks.

The (grout) powder shall be mixed with recommended quantity of water and stirred till a grout of smooth consistency is obtained. It shall be poured as soon as possible in order that the expanding properties are fully availed of. Where a thicker section is encountered, 10 mm chips may be added to the grout. This may slightly affect the flow properties of the grout and dditional powder may be needed to restore the same. Boltholes shall be filled in first and then the gap between the column base and base concrete grouted. It is essential that the grout

flow is continuous. For larger grouts suitable pumps shall be employed. The air must escape and shall not be trapped inside. Grouting shall not be done in extreme hot or cold weather.

12.8 FIELD INSPECTION

12.9 General

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

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

13.0 TESTING OF MATERIALS:

Structural steel shall be tested for mechanical and chemical properties as per various IS codes as may be applicable and shall conform to requirements specified in IS: 226, IS: 2062, IS: 11587,IS: 1977, IS: 8500 and IS: 96j1, etc.

Bolts, nuts, washers, welding consumables, steel forging, casting and stainless steel be tested for mechanical and chemical properties in the appropriate IS Code. Rolling and cutting tolerance shall be as per IS: 1852. The thickness tolerance check measurements for the plate and rolled sections shall be taken at not less than 15 mm from edge.

Lamination tests for plates shall be carried out by ultra-sonic testing or any other specified methods. Steel work shall be inspected for surface defects and exposed edge laminations uring fabrication and cleaning. Significant edge laminations found shall be reported to the Engineer for his decision.

Chipping, grinding, machining or ultrasonic testing shall be used to determine depth of imperfection.

13.1 BOLTED CONNECTIONS:

Bolts and bolted connection joints with high strength bolts shall be inspected and tested according to IS: 4000.

The firmness of joint shall be checked by 0.2 mm filler gauge, which shall not go inside under the bolt head by more than 3 mm. The alignment of plates at all bolted splice joints and elded butt joints shall be checked for compliance with Code requirements.

Testing of flame cut and sheared edges is to be done, where the hardness criteria given in the code are adopted. Hardness testing shall be carried out on six specimens.

13.2 WELDING AND WELDING CONSUMABLES:

Welding procedure, welded connection and testing shall be in compliance with Code requirements.

All facilities necessary for stage inspection during welding and on completion shall be provided to the Engineer or their inspecting Authority by manufacturer. Adequate means of identification either by identification mark or other record shall be provided to enable each weld to be traced to the welder(s) by whom it was carried out. All metal arc welding shall be in compliance with IS: 9595 provisions.

The method of inspection shall be in accordance with IS: 822 and extent of inspection and testing shall be in accordance with the relevant standards or in the absence of such a standard, as agreed with the Engineer.

Procedure tests -The Destructive and Non-Destructive test of weld shall be carried out according to IS: 7307 (Part I).

13.3 NON-DESTRUCTIVE TESTING OF WELDS

One or more of the following methods may be applied for inspection or testing of weld:

i) Visual Inspection: All welds shall be visually inspected, which should cover all defects of weld such as size, porosity, crack in the weld or in the HAZ (Heat Affected Zone) etc. Suitable magnifying glass may be used for visual inspection. A weld shall be acceptable by visual inspection if it shows that:

a) The weld has no cracks.

b) Through fusion exists between weld and base metal and between adjacent layers of weld metal.

c) Weld profiles are in accordance with requisite clauses of IS: 9595 or as agreed with the Engineer.

d) The weld shall be of full cross section, except for the ends of intermittent fillet welds outside their effective length.

e) When weld is transverse to the primary stress, undercut shall not be more than 0.8 mm deep when the weld is parallel to the primary stress in the part that is undercut.

f) The fillet weld in any single continuous weld shall be permitted to under run the nominal fillet weld size specified by 1.6 mm without correction provided that undersize portion of the weld does not exceed 10 percent of the length of the weld. On the web-to-

flange welds on girders, no under run is permitted at the ends for a length equal to twice the width of the flange.

g) The piping porosity in fillet welds shall not exceed one in each 100 mm of weld length and the maximum diameter shall not exceed 2.4 mm, except for fillet welds connecting stiffeners to web where the sum of diameters of piping or porosity shall not exceed 9.5 mm in any 25 mm length of weld and shall not exceed 19 mm in any 300 mm length of weld.

h) The full penetration groove weld in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the piping porosity shall not exceed one in 100 mm of length and the maximum diameter shall not exceed 2.4 mm.

(ii) Magnetic Particle and Radiographic Inspection: Welds that are subject to radiographic or magnetic particle testing in addition to visual inspection shall have no crack. Magnetic particle test shall be carried out for detection of crack and other discontinuity in the weld according to IS: 5334. Radiographic test shall be carried out for detection of internal flaws in the weld such as crack, piping porosity inclusion, lack of fusion, incomplete penetration, etc. This test may be carried out as per IS: 1182 and IS: 4853.

Acceptance Criteria: The weld shall be unacceptable if radiographic or magnetic particle testing shows any of the type of discontinuities indicated in the code.

(iii) Ultrasonic Inspection:

The Ultrasonic testing in addition to visual inspection shall be carried out for detection of internal flaws in the weld such as cracks, ping porosity inclusion, lack of fusion, incomplete penetration, etc. Acceptance criteria shall be as per IS: 4260 or any other relevant IS Specification and as agreed to by the Engineer.

(iv) Liquid Penetration Inspection:

The liquid penetrant test shall be carried out for detection of surface defect in the weld, as per IS: 3658, in addition to visual inspection. The non-destructive testing of following welds be carried out using one of the method or methods described at (ii), (iii) and (iv) above, as may be agreed to by the Engineer.

a) All transverse butt welds in tension flange.

b) 10 percent of the length of longitudinal and transverse butt welds in tension flanges.

c) 5 percent of the length of longitudinal and transverse butt welds in compression flanges.

d) All transverse butt welds in webs adjacent to tension flanges as specified by the engineer. The particular length of welds in webs to be tested shall be agreed with the Engineer in case of (b) or (c).

Where specified by the Engineer, bearing stiffeners or bearing diaphragms adjacent to welds, plates in box girder construction adjacent to plates at cruciform welds, plates in box girder

construction adjacent to corner welds or other details shall be ultrasonically tested after fabrication.

Any lamination, lamellar tearing or other defect found shall be recorded and reported to Engineer for his decision.

13.4 TESTING OF WELDING FOR CAST STEEL:

The testing of weld for cast steel shall be carried out as may be agreed to by the Engineer.

13.5 STUD SHEAR CONNECTORS (WHERE APPLICABLE)

Stud shear connectors shall be subjected to the following tests:

a) The fixing of studs after being welded in position shall be tested by striking the side of the head of the stud with a 2 kg hammer to the satisfaction of the Engineer.

b) The selected stud head stroked with 6 kg hammer shall be capable of lateral displacement of approximately 0.25 the height of the stud from its original position. The stud weld shall not show any sign of crack or lack of fusion.

The studs whose welds have failed the tests given in (a) and (b) shall be replaced.

13.6 INSPECTION REQUIREMENT:

The fabricated member/component made out of rolled and built-up section shall be checked for compliance of the tolerances given in Table-2. Inspection of member/components for compliance with tolerances, and the check for deviations shall be made over the full length. During checking, the inspection requirement shall be placed in such a manner that local surface irregularities do not influence the results. For plate, out-of-plane deviation shall be checked at right angle to the surface over the full area of plate.

The relative cross frame deviation shall be checked over the middle third of length of the girder or frame between each pair of webs and for cantilever at the end of member. The web of rolled beam or channel section shall be checked for out-of-plane deviation in longitudinal direction equal to the depth of the section.

During inspection, the component/member shall not have any load or external restraint.

13.7 INSPECTION STAGES:

The inspection to be carried out for compliance of tolerances shall include but not be limited to the following stages:

a) For completed parts, component/members on completion of fabrication and before any subsequent operation such as surface preparation, painting, transportation, and erection.

b) For webs of plate and box girder, longitudinal compression flange stiffeners in box girders and orthotropic decks and all web stiffeners at site joints, on completion of site joint.

c) For girders and frames, cantilevers and other parts in which deviations have apparently increased on completion of site assembly.

Where, on checking member/component for the deviations in respect of out-of-plane or out of-straightness at right angles to the plate surface, and any other instances, exceed tolerance, the maximum deviation shall be measured any recorded. The recorded measurements shall be submitted to the Engineer who will determine whether the component/member may be accepted without rectification, with rectification or rejected.

14.0 PAINTING

14.1 General Scope

a) Surface Preparation

Steel surface shall be free of any impurities like rust, dirt, oil, etc. and shall be prepared in thorough manner with a view to ensuring complete removal of mill scale by thorough cleaning with wire brushes and sandpapering.

Primary coat shall be applied as soon as practicable after the surface preparation is completed. All slag from welds shall be removed before painting. Care shall be taken to brush the surface clean prior to painting. Surfaces shall be maintained dry and free from dirt and oil. Working out-doors and in frosty or humid weather shall be avoided. The undercoat and finishing coat shall be of the same manufacturer. Successive coats of paints shall be of different shades and colours and each shall be allowed to dry thoroughly before the next is applied. Particular care shall be taken with the priming and painting of edges corners, welds and rivets.

b) Sand blasting

Sand blasting for surface preparation shall be done if mentioned specifically in the Bill of Quantities. This shall be carried out in the special treatment facility required for sandblasting. The finish achieved after sandblasting shall confirm to grade SA 2.5

Unless otherwise specified, all steelwork shall be given approved primer and top coats of painting. The work shall include cleaning as indicated hereinafter or sand / grit blasting of steel to Swedish specification 2-1/2 if specifically mentioned in the Schedule of quantities and other preparation of metal surfaces as required, providing and applying the paint in the specified number of coats and thickness (with repair / touching of the shop / first coat / other coats as necessary) including supply of all materials, equipment, tools and tackles, scaffolding, labour, supervision, thickness testing instruments, all testing, materials and all and other work to complete the painting as per specifications and to the satisfaction of the Engineer.

14.2 QUALITY OF PAINT

Only the paints which have been tested for the following qualities as per the specification given in the relevant IS codes should be used:

- weight test (weight per 10 litre of paint thoroughly mixed) o drying time o flexibility and adhesion
- consistency
- dry thickness and rate of consumption

Unless otherwise specified all painting and protective coating work shall be done in accordance with IS: 1477 (Part 1)

14.3 PREPARATION OF STEELWORK

The steelwork shall be thoroughly cleaned and all grease, oil and all other surface contaminants shall be removed by application of solvents, wire brushing and other tools. The steelwork shall be grit / sand blasted if specifically mentioned in the Schedule of quantities to degree defined as 2-1/2 as per Swedish Standard SI S 05 5900 with a surface profile not exceeding 65 microns. It must be ensured that the steel is clean and free of all contaminants. The longevity of the coating and protection will depend on the extent to which the steel is clean. All dust is removed and the steelwork.

The steel after grit / sand blast cleaning is very susceptible to atmospheric action and as such within as short a time as possible (not more than 15 to 20 mins) the first coat of primer shall be applied.

14.4 PAINT PREPARATION AND APPLICATION PROCEDURE

The primer shall be an inorganic Zinc silicate solvent based paint normally of the two pack self curing type. The liquid part is thoroughly stirred to uniform consistency and then the solid part (zinc dust) shall be added with constant mechanical stirring till the powder is thoroughly dispersed. The mixture is strained through a 80 mesh sieve and allowed to mature for 20 minutes with stirring. It is then applied by airless spraying with a pump ratio of 30 : 1, a tip size of 0.40 mm and a pressure of 120 kg / sq.cm The wet film thickness shall be not less than 125 microns and the dry film thickness 75 microns. One coat of primer shall be applied with a DFT of not less than 75 microns.

The intermediate coat shall be of a super high-build epoxy coating with a composition of catalysed epoxy resin suitably pigmented. This is in two packs. The separate packs are stirred properly and mixed in the recommended ratio. The mixture shall be applied to the clean primer surface by airless spray (pump ration 45:1) with a fluid tip of about 0.55 mm
and air supply of 100 psi. The pot life of the mixture is an hour. At approximately 4.25 sq.m per

litre, a 200 micron DFT should be available.

The topcoats shall be two coats of an acrylic polyurethane enamel for a high gloss coating to provide protection against the atmosphere at site.. The steelwork which has already been primed with one coat and given an intermediate coat shall be carefully cleaned of adhering contaminant without damaging the coats.

The top coat paint also comes in two packs, base is stirred thoroughly and the catalyst is added in the ration of four parts of base to one part of catalyst. The mixture is stirred to uniform consistency and after a maturing period of 30 minutes, the top coats shall be applied by air less spray with pump ratio of 30:1, a tip between 0.40 and 0.45 mm at a tip pressure of 140 kg / esq. There shall be two topcoats each of DFT of 30 microns.

The prime and top coats shall be compatible with each other. The surface of the steelwork shall be clean dry before the application of any paint. The painting equipment shall be kept scrupulously clean and for this purpose, a thinner shall be used for cleaning the equipment before and after use. It must be ensured that all paints are fresh and whenever the contents of two pack paints are mixed the paint must be used up before the time recommended by the manufacturers. The colour of the topcoats shall be selected by the Engineer. Two slightly different shades may be chosen to ensure that two topcoats are given without missing out any area of the steel work.

14.5 CURING

The painted materials shall not be handled till it is dry. The painted components shall be allowed to air-dry for at least 24 hours after which it should be gradually subjected to working temperature range.

14.6 AMBIENT CONDITIONS AND PAINTING

Painting work shall not be done if the ambient temperature is below 10 0 C or if it is above 50 0 C, nor shall it be done if the relative humidity is above 90 %. No painting work shall be done during rain or misty or foggy conditions. As far as possible coated surface shall not be exposed to rain or forest before they are dry.

14.7 OTHER REQUIREMENTS

The coatings shall be applied to all surfaces excluding inner surfaces of fully sealed hollow sections. Surfaces that would be inaccessible for cleaning and painting after fabrication shall be painted as specified before being assembled. All bolts, nuts, washers etc. are to be thoroughly cleaned and dipped into boiling linseed oil conforming to IS: 77. All machined surfaces are to be well coated with a mixture of white lead conforming to IS: 234 and Mutton Tallow conforming IS: 887.

The work shall be done inside a properly covered area by workmen who are properly attired and protected for the work. All fabricated steel shall be painted in the shops after inspection and

acceptance with at least one priming coat, unless the exposed surfaces are subsequently to be cleaned at site or are metal coated. No primer shall be applied to galvanised surfaces. Field contact surfaces and surfaces to be in contact with cement shall be painted with primer only. No paint shall be applied within 50 mm of designed location of field welds.

15.0 MEASUREMENTS & RATES

The contractor will be paid on the basis of unit rates quotes for structural steel work. Measurements will be based on the actual weight of structural steel erected as shown on drawings or as specified. The weight of the temporary bracings, shims and erection bolts, fields welding, if any will not be taken into account for purpose of payment. The rate for erection shall be inclusive of structural welding wherever specified and painting as called for the specification and drawings. All bolts, nuts and washers which are permanently incorporated in the structures other than those specifically paid for separately shall be provided by the contractor and the rate quoted for the erection of structural steel shall include the cost of supply and erection of such bolts, nuts and washers.

The unit rates shall include all materials, labour, supervision, tools and plant, apparatus, conveying equipment, incidental expenses etc., other than those supplied free by Engineerin-Charge, nuts, bolts and washers etc. The unit rate also includes removal of paint from members encased in concrete. The unit rate shall also includes providing & applying priming coat and final coat of paints as per schedule of quantities.

16.0 STEEL TUBES FOR STRUCTURAL PURPOSES

All structural steel tubular members shall confirm to IS: 1161-1979, grade of steel shall be Yst-210. All other specifications including fabrication, erection, painting, measurements etc. shall conform to the detailed specification given under structural steel works.

17.0 STAINLESS STEEL TUBES & PLATES

Stainless steel tubes & plates shall comply standard of Grade 316 / 304 as described in the Schedule of Quantities conforming to American Iron & Steel Institute. It should contain Nickel @ 8 to 10.50% and Chromium @ 18 to 20%. It should be non magnetic type with minimum wall thickness of 1.50mm or as specified in the drawing. The fixing of railing pipe with vertical SS pipe & SS plate shall be carried out by welding with special electrodes used for stainless steel welding. SS plate shall be fixed to the concrete with the help of wedge bolts.

BRICK WORK

CONTENTS

1.0 SCOPE

These specifications cover the use of Brick Masonry for the structural purposes.

2.0 GENERAL

The provision of the latest Indian Standards listed below form part of these pacifications: IS: 1077 Specifications for common burnt clay building bricks

IS: 1200 Measurement for Building works

IS: 1725 Specifications for solid cement blocks used in general building construction.

IS: 1905 Code of practice for structural safety of buildings Masonry walls.

IS:2116 Sand for masonry mortars.

IS:2180 Specification for heavy duty burnt clay building bricks

IS:2185 Specification for concrete masonry units: Hollow and solid concrete blocks.

IS:2212 Code of practice for brick work.

IS:2222 Specification for burnt clay perforated building bricks.

IS:2250 Code of practice for preparation and use of masonry mortar. IS 2645 Specification for integral waterproofing compound.

IS:2691 Specification for burnt clay facing bricks.

IS:3115 Specification for lime based blocks.

IS:3414 Code of practice for design and installation of joints in buildings.

IS:3466 Specification for masonry cement.

IS:3861 Method of measurement of plinth, carpet and rent able areas of buildings. IS:3952 Specification for burnt clay hollow blocks for walls and partitions.

IS:4098 Specification for lime-puzzolona mixture

IS:4139 Specification for sand lime bricks

IS:4441 Code of practice for use of silicate type chemical resistant mortars.

IS:4442 Code of practice for use of sulphur type chemical resistant mortars.

IS: 5495 Size & shape for fire bricks

IS 8112 Specification for high strength ordinary portland cement IS 9103 Specification for admixtures for concrete.

Other I.S. Codes not specifically mentioned here but pertaining to the use of bricks for structural purposes form part of these specifications.

2.1 MATERIALS

2.2 Bricks

Bricks shall be of regular and uniform size, shape and colour, uniformly well burnt throughout but not over burnt. They shall have plane rectangular faces with parallel sides and sharp straight and right angled edges. They shall be free from cracks or other flaws. They shall have a frog of 10 mm. depth on one of their flat faces.

They shall give a clear metallic ringing sound when struck. They shall show a fine grained, uniform homogeneous and dense texture on fracture and be free from lumps of lime, laminations, cracks, air holes, soluble salts causing efflorescence or other defects which may in

any way impair their strength, durability, appearance or usefulness for the purpose intended. They shall not have any parts under-burnt. They shall not break when thrown on the ground on their flat face in a saturated condition from a height of 60 cm.

Size of bricks
Bricks shall comply with I. S: 1077 - 1976.

Absorption
After immersion in water, absorption by weight shall not exceed 20% of the dry weight of the brick when tested according to IS: 1077-1976.

Crushing Strength
The load to crush the brick when dry shall not be less than 50 Kg/sq.cm. and when thoroughly soaked shall not be less than 35 Kg/sq.cm.

2.3 CEMENT, FINE AGGREGATE AND WATER

Refer relevant clauses of these specifications.

2.4 MORTARS

Cement and sand shall be mixed in specified proportions given on the drawings. Cement shall be proportioned only by weight, by taking its unit weight as 1440 kg per cubic metre and the sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

The mixing shall be done intimately in a mechanical mixer unless hand-mixing is specifically permitted by the Engineer. If hand mixing is done, the operation shall be carried out on a clean watertight platform and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. The mortar so prepared *shall* be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes. The mortar remaining unused after that period or mortar, which has partially hardened or is otherwise damaged shall not be re-tempered or re-mixed. It shall be destroyed or thrown away. In case of cement mortar that has stiffened because of evaporation of water the same shall be re-tempered by adding water as frequently as needed to restore the requisite consistency, but this re- tempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

Necessary tests to determine compressive strength of the mortar, for consistency of the mortar and its water retentively shall be carried out in accordance with IS-2250. The frequency of testing shall be one cube for every 2 cubic metre of mortar prepared subject to a minimum of 3 cubes for a day's work.

3.0 CONSTRUCTION

3.1 SOAKING OF BRICKS

Bricks shall be soaked in water for a minimum period of one hour before use so that they will be saturated and will not absorb water from the mortar. When bricks are soaked they shall be removed from the tank sufficiently in advance so that at the time of lying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not spoil by dirt, earth, etc.

3.2 Laying of Bricks

4.2 LAYING OF BRICKS

All brick work shall be laid in English bond, even and true to line, plumb, level and all joints accurately kept. The bricks used on the face shall be selected whole ones of uniform size and with true rectangular face. Brick shall be laid with frogs up, if any, on a full bed of mortar. When laying, bricks shall be slightly pressed so that the mortar gets into all the surface pores of bricks to ensure proper adhesion. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left. Before laying bricks in foundation, a layer of not less than 12 mm of mortar shall be spread to make the surface on which the brickwork will be laid even. Immediately thereafter, the first course of bricks shall he laid.

The brickwork shall be built in uniform layers, corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. No part of it, during construction, shall rise more than one meter above the general construction level, to avoid unequal settlement and improper joining. The height of brick works constructed shall not exceed one metre in a day. Toothing may be done where future extension is contemplated but shall be used as an alternative to raking back..

All brick walls abutting concrete columns or walls shall be bonded to the same with approved 6mm dia 250 mm long galvanized M.S. dowels or approved G.I. butterfly ties left from the concrete columns while casting, at every 9th course of brick..4.3 Joints. The thickness of joints shall not exceed 10mm and this thickness shall be uniform throughout.

4.3 JOINING WITH EXISTING STRUCTURE

When fresh masonry is to be placed against existing surfaces of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer so as to affect a good bond with the new work.

4.4 CURING

Green work shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day. During hot eather all finished or partly completed work shall be covered or wetted in such manner as will prevent rapid drying of the brick work.

4.5 SCAFFOLDING

The scaffolding shall be sound and strong to withstand all loads likely to come upon it and will be double as is warranted for the particular work. The holes, which provide resting space for horizontal members, shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with 1:4:8 cement concrete.

4.6 CONDITION OF EQUIPMENT

All equipment used for mixing or transporting mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.

4.7 FINISHING OF SURFACES

For a surface which is to be subsequently plastered or pointed the joints shall be squarely raked out to a depth of 15mm while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

4.0 MEASUREMENT FOR PAYMENT

4.1 All brick work for 230mm thick or above shall be measured in cubic metres and 115mm thick and below shall be measured in sq.metres. The work of plastering and pointing shall be measured in square metres of the surface treated.

4.2 Rate :- The contract unit rate for brick work shall include the cost of all labour, materials, tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above and as shown on the drawings. The rate for work shall also include:

(i) Dewatering required for completing this item and till the mortar of masonry pointing & plastering is properly set

(ii) watering the masonry and

(iii) cleaning the site round the brick-work so as to restore the area to its original condition.

The rate for work shall also include full compensation for using specially moulded bricks on the face of walls with batter and provision of weep holes.

PLASTERING & POINTING

CONTENTS

1.0 SCOPE

These specifications cover the use of plastering for masonry and RCC work, pointing for brick and stone masonry work.

2.0 APPLICABLE INDIAN STANDARDS

The provision of the latest revisions of the following IS codes shall form a part of this specification to the extent they are relevant.
IS: 269 Specification for ordinary rapid hardening and low heat Portland cement
IS – 383 Specification for coarse and fine aggregate
IS: 712 Building Limes
IS: 1200 (Part XII) M ethod of measurement of building and Civil Engg. Works Plastering & Pointing
IS: 1542 Specification for sand for plaster
IS: 1630 Mason's Tools for Plaster work and pointing work.
IS: 1661 Code of practice for application of cement lime plaster finishes IS 2645
Specification for integral waterproofing compound.
IS: 10067 Material Constants for Building Works
Other I. S. Codes, not specifically mentioned here, but pertaining to plastering work, form part of these specifications.

3.0 GENERAL

3.1 Cement Mortar

Cement mortar shall have the proportion of cement to sand as specified and shall comply with relevant clauses of concrete specifications.

3.2 Scaffolding,

Scaffolding independent of masonry / RCC work i.e. double scaffolding shall be erected having two sets of vertical supports with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

3.3 Tools and Accessories

Tools and accessories used in plaster work shall conform to IS: 1630. All tools shall be cleaned by scrapping and washing at the end of each day's work or after use. Metal tools shall be cleaned after each operation. All tools shall be examined to see that they are thoroughly cleaned before plastering is begun.

3.4 Programme of work in relation to plastering

The programme of other building operations before, during and after plastering shall be according to the instructions contained in clause 9 of IS: 1661.

3.5 General Precaution in plastering

All general precautions as specified in IS.. 1661, Clause 9, shall be taken and preparation of the

background shall be done as laid down in IS: 1661, Clause 13. Care shall be taken to see that other parts of the work or adjacent works are not damaged while plastering.

3.6 Preparatory work

All joints in the face work that is to be plastered shall be raked out to depth equal to not less than the width of the joints or as directed by the Engineer. The raking shall be done taking care not to allow by chipping of masonry. In new work the raking out shall be done when the mortar in the joints is still green. Efflorescence if any shall be removed by brushing and scrapping. Smooth surfaces of concrete, old plaster, etc. must be suitably roughened to provide necessary bond for the plaster. All dirt, soot, oil paint or any other material that might interfere with satisfactory bond shall be removed. In the case of stone masonry, scrubbing on the walls to receive the plaster shall not be more than 12 mm. The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work. The plastering shall not be commenced unless the preparatory work is passed in writing by theEngineer.

3.7 Chicken wire Mesh at Junction

All junctions of Masonry wall with R.C. structure e.g. column, beam, etc. which are to be plastered, shall be reinforced by fixing strips of approved G.I. Chicken wire mesh of minimum 300mm wide centrally over the length of junction. G.I. Chicken wire mesh of required width shall also be fixed over chasing for conduits, pipes, etc. on masonry walls before plastering is commenced. The mesh shall be nailed rigidly to the structure / masonry with G.I. nails of suitable type at approx. 400mm centers. The finished mesh shall be straight, rigid and laid without sagging.

3.8 Gauges

Patches of plaster 15cm x 15cm shall be put on about 3 m apart as gauges to ensure even plastering in one plane.

3.9 Workmanship

Plastering:

In all plaster work the mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joints and on the surface and rubbed and levelled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to give perfectly plane and even surface. All corners must be finished to their true angles or rounded as directed by the Engineer. The surface shall be finished to plane or curved surface as shown on the plan or directed by the Engineer, and shall present a neat appearance. The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. Cement plastering should be done in squares or strips as directed. Plastering shall be done from top downward.

First or Backing Coat

The first coat of the specified thickness shall be applied as described above. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

3.10 Plastering to Ceiling

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed.

The surface shall be scrubbed clean with wire brushes. In addition concrete surface shall be poke marked with a pointed tool at spacing of not more than 50 mm centres, the pokes being

made not less than 3 mm deep, to ensure a proper key for the plaster. The mortar shall be washed off and surface cleaned of all oil, grease etc., and well wetted before the plaster is applied.

4.0 POINTING

4.1 General

When the type of pointing is not mentioned in the item, sunk pointing is described below shall be carried out.

4.2 Raking Out Joints

Where the joints have not been raked out when the mortar is green, the joint shall be chipped (without damaging the masonry) to such a depth that the minimum depth of new mortar measured from either the sunk surface of the finished surface of the finished pointing or from the edge of the brick shall not be less than 12 mm, thoroughly cleaned off all loose particles with a stiff brush and thoroughly wetted.

4.3 Pointing

The mortar shall be pressed into the raked out joints with a pointing trowel. The mortar shall not spread over the corners, edges or the surface of the masonry. With a pointing tool, the mortar shall be neatly pressed back to about 3 mm or as directed. The vertical 'joints shall be pressed back similarly to match the horizontal joints. The surface of masonry shall be cleaned of all mortar.

5.0 CURING

Curing shall be started after 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days. During this period it shall be suitably protected from all damages as directed by the Engineer-in-Charge. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be monitored.

7.0 MEASUREMENT AND RATE

Plastering shall be measured in sq. metre areas as per IS: 1200 (Part XII). The rate shall include erecting and removal of scaffolding all labour, all materials, equipment, plants, tools and all incidental expenses to complete plastering, pointing, rubbing out joints, cleaning, wetting, filling with cement mortar, troweling etc. and making of drip moulds, grooves, vattas, bands etc. including curing.

WATER PROOFING

CONTENTS

1.0 SCOPE

These specifications cover damp proofing (excluding water under pressure) against seepage, lateral or rising moisture, water proofing against water / water under hydrostatic pressure. The work shall also cover related work such as cleaning the surfaces, application, all testing, rectification / replacement of defective work and any other work necessary to complete the work as per drawings, specifications and the directions of the Engineer.

Water proofing shall be by one of the following methods as specified in the schedules and drawings – by bitumen felts and coats, by integral water proofing chemical compounds, by application of chemicals forming a film on external face of structure, by grouting of concrete with water proofing chemicals.

The Contractor shall provide all materials, transportation, tools and tackles, labour and supervision and other related work for the work of water proofing various components of structures by different materials and procedures.

2.0 CODES AND SPECIFICATIONS

The following codes and specifications will be applicable. In general work shall be done as per the latest editions of the applicable Indian Standards some of which are listed below. Where Indian Standards are not available, relevant British / ASTM Standards shall be referred to.

CODES	DESCRIPTION
IS: 269	Specification for ordinary rapid hardening and low heat Portland cement
IS – 383	Specification for coarse and fine aggregate
IS: 2645	Integral cement water proofing compounds
IS: 3067	Preparatory work for water proofing of buildings
IS: 3495	Method of test for burnt clay building bricks.
IS: 6494	Waterproofing of underground reservoirs and swimming pools
IS: 7290	Recommendations for use of polyethylene film for water proofing of roof.
IS: 8112	Specification for 43 grade ordinary Portland cement
IS: 10067	Material Constants for Building Works
IS : 12118	Two parts polysulphide based sealents

Other I. S. Codes, not specifically mentioned here, but pertaining to water-proofing work, form part of these specifications. Where specialized chemicals are used for waterproofing, work shall be done as per manufacturer's recommendations for best practice.

3.0 GENERAL

It should be noted that concrete should itself be properly laid the proportion so designed, mixed and laid to form as dense a concrete while in conformity with the specifications. Before applying any compound the face of concrete shall be rubbed down smooth and free of any contaminants and loose materials.

All materials should be new, of fresh manufacture and stored and handled properly. Chemicals shall be stored and handled as per the manufacturer's recommendation and used well before the shelf life period expires. Where specialist chemicals are used, manufacturer's recommendations shall be followed in the use of the chemicals.

4.0 INTEGRAL WATER PROOFING

In order to improve water tightness in retaining walls and in locations where waterproof concrete is required, integral water proofing chemicals / compounds shall be added to the concrete. These shall conform to IS: 2645 and shall be chloride free. The material is generally in powder form and has to be made into a solution with the prescribed quantity of water before it is added to the concrete. The dosage to be added is of the order of 1.5 % to 2 % of the weight of cement. The total water cement ratio should be as per the code for the particular grade of concrete and the mix design. While using a particular product, the recommendations of the manufacturer shall be given due weight.

5.0 WATERPROOFING OF UNDERGROUND STRUCTURES

In underground structures, swimming pool etc, necessary precautions shall be taken as detailed below, before the application of waterproofing treatment

a) The concrete used in the walls shall contain integral waterproofing compounds as specified in paragraph 4.0 above.

b) The retaining wall shall also be grouted with cement slurry to which water-soluble waterproofing compound the grouting being done to refusal

Where specified on the drawings or directed by the Engineer, 12 mm nozzles shall be provided on the surface of the wall of the structure in a grid of 1.5 m both ways before concreting. During concreting operations, the nozzles shall be properly protected to prevent the nozzles from being clogged with concrete. (If holes are to be made in set concrete they shall be made by careful drilling of the concrete and then grouting the nozzles.). After the nozzles are set, slurry with neat cement and a chloride free expanding grout shall be injected through the nozzles with low pressure grout pumps (pressure around 2 kg / sq.cm). Water cement ratio should be restricted to

0.35 to 0.40 and viscosity not more than 1.2 centipoises. If necessary plasticizing agent can also be used. Grouting pressure shall be low at the start of the operations and increased gradually (but within limits so as not to harm the concrete) till completion and refusal of grout. After a suitable interval, the nozzles shall be properly sealed after the approval of the Engineer. (Intraplast EP or N 200 / Cebex 100 / suitable product of the Excem range or any equivalent product can be used.Important requirements – suitability for the purpose, expanding type, absence of chloride etc

5.0 CEMENT BASED WATERPROOFING

5.1 The treatment shall be laid directly over the R.C.C Slab, the detailed operations are as follows:

a) After the RCC slab has been cleaned slurry coat consisting of the neat cement admixed with specialised acrylic based chemicals which penetrate in the minutest of crevices and fill up all the porosity in the structure shall be used. In case of construction joints between different

R.C.C members the chemicals mixed with neat cement slurry shall be injected at joints to make them monolithic.

b) A layer consisting of half cut bricks in cement mortar 1:4 (1 cement : 4 coarse sand) admixed with acrylic based chemicals to necessary gradient for proper flow of water towards the drain is then laid. The treatment will be extended upto 300 mm height of parapet walls

also. The average thickness of this brick bat coba shall be 120 mm with a minimum thickness of 75 mm at the drain.

After a proper curing for about 3 days once again slurry coat consisting of cement slurry mixed with waterproofing chemicals is provided to fill in the joints.

c) The top is then finished smoothly with cement mortar 1:4 (1 cement : 4 coarse sand) with acrylic based chemicals, such topping shall be of 25 mm thickness marked with 300 x 500 mm false rectangles and the joints between slab and walls shall be rounded off in the form of vata.

The whole terrace shall be flooded with water for a period of 2 weeks for curing and for final test.

d) The proportion of the chemicals to be used in respect of ordinary Portland cement shall be 1% by weight i.e. 1 Kg of chemicals shall be mixed with 100 Kg ordinary cement and the quantity of cement used shall be a minimum of 5 bags per 9.29 sq.m of the area treated.

e) Mode of Measurement

For treatment over terrace

Treatment to Horizontal areas and vertical areas (wattas/core) will be measured together. Horizontal areas will be measured wall to wall faces before application of treatment and vertical areas will be measured from top of horizontal finished treatment to top of wattas/core vertically along wall of face and not girthed.

7.0 IMPREGNATION (EXTERNAL) TREATMENT TO THE BASEMENT AND UNDERGROUND WATER TANK STRUCTURE.

The underground structure shall be treated with the impregnation treatment during the initial stage of construction to ensure 100% water tightness. Preparatory works shall be carried out as per clause 5.0 above.

7.1 The impregnation layers shall be laid over the evenly laid bedding course of concrete after cleaning the surface. Rough stone slabs are then laid side-by-side leaving a gap of about 15 mm to 20 mm between them. These joints thus left are raked open and cement slurry admixed with chemicals is grouted in these joints. A protective layer of about 25 mm thickness of cement mortar 1:5 (1 cement : 5 Coarse sand) with stone chips embedded at random is put over the stone layer. The total thickness of the waterproofing layer shall be minimum of 75 mm. The treatment is extended 150 mm beyond the external face of the RCC raft slab and where side walls are laid the treatment shall be carried over to the side walls.

7.2 The impregnation treatment shall be continued to the external sides of the walls and upto 300 mm above ground level. The procedure shall be as follows:

Rough stone slabs of thickness 12 mm to 16 mm shall be fixed with the help of cement paste applied on the internal face of the vertical joints of the stones, leaving a gap of about 18 mm between the external face of RCC wall and internal face of the rough stones. The stones are fixed side by side without leaving any gap between the edges. In order to fix the bottom most layer of stones a groove about 25 mm deep is made in the bottom RCC slab and the stones fixed in it to ensure the water tightness at the junctions of the walls and raft if the raft is projecting beyond the external face of walls. Maximum of two to three horizontal layers of

rough stones are laid at a time. A coat of very rough cement plaster 1:5 (1 cement: 5 Coarse sand) is applied to the external face of rough stones. After the layer is set, the gap between the walls and the stones layer is filled with a grout mix made up of cement slurry and acrylic based chemicals, which on gellation forms an impermeable monolithic layer. The treatment is then continued upto 300 mm above the ground level in stages.

8.0 TOILET BLOCK WATERPROOFING

i) Treatment to include filling in the depressions with waterproof brickbat coba and top surface finished rough to receive flooring tiles.

ii) Special treatment shall be carried out on the walls upto a height as specified (minimum 1.0 metre) above finished floor level. The thickness of this waterproofing treatment on walls will be 10 to 18 mm. The treated surface of the walls will be left rougher to receive dado tiles over them. The toilet block waterproofing shall be carried out only after the required plumbing and drainage works are completed and tested. Rate quoted shall include for making good of walls at required height, for tucking the treatment on vertical surface.

iii) Cement mortar in a ratio of 1 : 4 (1 cement : 4 Coarse sand) shall be laid with 2% water-proofing compound over the water-proofed area / depressions where brick bat filling is to be carried out, after the area duly tested & approved by the Engineer. Brick bats shall be laid in layers and grouted in cement mortar (1:4) with 2% water-proofing compound upto the required level and top surface finished rough to receive flooring tiles.

iv) Mode of measurement

Treatment to horizontal and vertical areas will be measured separately for treatment carried out in the sunk floor of bath/WC etc. the flat area of the respective sunk floor shall be measured.

The area of treatment to the walls shall be measured by calculating the perimeter of unfinished walls of bath/WC and multiplying the same by the height of the treatment above finished treated level of such floor of batch & WC.

9.0 WATERPROOFING GUARANTEE CLAUSE

The contractor shall be fully responsible for and shall guarantee proper performance of the entire waterproofing system for a period of 10 (Ten) years from the final completion of works. In addition, specific 10 years written guarantee (to be furnished in a nonjudicial stamp paper of value not less than Rs.100/-) in approved proforma shall be submitted for the performance of the system, before final payment and shall not in any way limit any other rights the Employer may have under the contract.

All water-proofing work shall be carried out through an approved specialist agency as per method of working approved by the Engineer. Contractors and the waterproofing agency shall be jointly responsible for waterproofing treatment until the expiry of the above guarantee period.

PROFORMA FOR PERFORMANCE GUARANTEE FOR WATER PROOFING WORKS

(On non-judicial stamp paper of value Rs. 100/-)

To
(Name & Address of Employer)
……
……
……

We hereby guarantee the Entire Waterproofing System, which we have carried out in the Complex described below:

Building : …… ……. …… …… ……. Location : ……

……. …….

Employer : …….. …….. …….. …….. .

For a period of 10 (Ten) years from the certified date of completion, WE AGREE TO repair or replace to the satisfaction of the Employer, any or all such work that may prove defective in workmanship or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above-mentioned conditions within a reasonable time, after being notified in writing, we collectively and separately, do hereby authorise the Employer to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

Signature of the Contractor

For M/s. …… …….

Address & seal

Date:

Witness:

PAINTING

CONTENTS

1.0 SCOPE

These specifications cover the use of paints for the plastered and concrete surfaces. It also includes the painting of wood and metal surfaces.

2.0 GENERAL

The provisions of the latest revisions of the following ARE: Codes shall form a part of this specification.

IS: 63 Whiting for Paint & putty.
IS: 75 Specification for Linseed oil, raw & refined.
IS: 159 Specification for ready mixed paint, brushing, acid resistant.
IS: 345 Specification wood filler, transparent, liquid.
IS: 426 Specification for paste filler for colour coats.
IS: 427 Specification for Distemper, dry colour, as required.
IS: 428 Specification for Distemper, Oil Emulsion, colour as required.
IS: 533 Specification for Gum spirit of Turpentine (Oil of Turpentine) IS:
710 Marine Plywood
IS: 1200 (Part XIII) Method of Measurement of Building & Civil Engg Works – White Washing, colour washing, distempering & other finishes.
IS: 1477 (Part 1) Code of practice for painting of ferrous metals in buildings Pretreatment
IS: 1477 (Part 11) Code of practice for finishing of ferrous metals in buildings, Painting
IS: 2338 (Part 1) Code of practice for finishing of wood and wood based materials Operations and workmanship for finishing.
IS: 2338 (Part 11) : Code of practice for finishing of wood and wood based materials, Schedule
IS: 2395 (Part 1) : Code of practice for painting concrete masonry and plaster surfaces. Operation & workmanship
IS: 2395 (Part 11) Code of practice for painting concrete, masonry and plaster surfaces. Schedule.
IS: 2524 (Part 1) Code of practice for painting of non-ferrous metal in buildings Pre-treatment
IS: 2524 (Part ll) Code of practice for painting of non-ferrous metal in buildings Painting
IS: 3140 Code of practice for painting asbestos cement buildings:
IS: 3537 Specification for ready mixed paint, finishing, interior for general purposes to IS colour.
IS: 5410 Specification for cement paints, colour as required.
IS : 6278 Code of practice for white washing & colour washing. Other IS Codes not specifically mentioned here, but pertaining to painting form part of these specifications.

3.0 MATERIALS

Materials shall strictly conform to the relevant IS: Specifications.

4.0 PLASTERED OR CONCRETE SURFACES

4.1 General

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be painted. A properly secured and well tied suspended platforms (JHOOLA) may be used for painting. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. For painting of ceilings, proper stage scaffolding shall be erected, where necessary.

Preparation of surfaces:

The surface shall be thoroughly cleaned off all dirt, dust, mortar dropping and other foreign matter, before paint is to be applied. New plaster surfaces and wet patches shall be allowed to sufficiently dry , before applying paint. All unnecessary nails shall be removed. Pitting in plaster shall be made good with putty. The surface shall then be rubbed down again with a fine grade sand paper and made smooth.

The surface shall be allowed to dry thoroughly before the regular coat of paint is allowed.

The surface affected by moulds moss, fungi, algaelicnens, efflorescence shall be treated in accordance with IS 2395 (Part 1) before applying paint.

4.2 ACRYLIC DISTEMPER

Preparation of Surfaces:

Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

Primer Coat:

The primer where used as on undercoated surfaces shall be alkali resistance primer or distemper primer as specified in the item. These shall be of the same manufacture as of acrylic distemper. If the wall surface plaster has not dried completely alkali resistance primer shall be applied before distempering the walls. But if the distempering is done after the wall surface is dried completely, distemper primer shall be applied.

Application:

Primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil bound distemper or paint is applied. Preparation of acrylic distemper:

The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared.

Application of distemper coat:

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand

papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed to immediately by vertical which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit the proper drying of the preceding coat. The finished surface shall be even and uniform without patches, brush marks, distemper, drops, etc.

Sufficient quantity of distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day. 15 cm. double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes, which are dirty and caked with distemper, shall not be used on the work.

4.3 WATERPROOF CEMENT PAINT

Preparation of Surfaces

The surfaces shall be thoroughly wetted with clean water before the water proof cement paint is applied.

Preparation of Paint

Portland cement paints are made readily by adding paint powder to water and stirring to obtain a thick paste which shall then be diluted to a brushable consistency. Generally equal volumes of paint powder and water make a satisfactory paint. In all cases the manufacturer's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flow and finish.

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 hydroscopic qualities. Application of Paint:

No painting shall be done when the paint is likely to be exposed to a temperature of below 7°C within 48 hours after application.

When weather conditions are such as to cause the paint to dry rapidly, work shall be carried out in the shed as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period. To maintain a uniform mixture and to prevent segregation the paint shall be stirred frequently in the bucket.

For undecorated surfaces, the surface shall be treated with minimum two coats of waterproof cement paint. Not less than 24 hours shall be allowed between two coats and the second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather the

preceding coat shall be slightly moistened before applying the subsequent coat.
The finished surface shall be even and uniform in shade without patches, brush marks, paint drops, etc.

Cement paints shall be applied with a brush with relatively short stiff hog or fibre bristles. The paint shall be brushed in uniform thickness and shall be free of excessively heavy brush marks. The laps shall be well brushed out.

Curing
Painted surfaces shall be sprinkled with water two or three times a day. This shall done between coats and for at least three days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after its application.

Rate
The rate shall include the cost of all labour and materials involved in all the above operations (including priming coat) as described above.

5.0 PAINTING WOOD AND METAL SURFACES

5.1 General Requirement :

The materials required for the execution of painting work shall be obtained directly from approved manufacturers and brought to the site in maker's drums, with seals unbroken. All paints shall conform to relevant Indian Standards as mentioned under sub-head "Material".

All materials not in actual use shall be kept properly protected. Lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. Materials which have become stale or fat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in the smaller container. No left over paint shall be put back into stock tins. When not in use, the containers shall be kept properly closed.
If for any reason thinning is necessary, in case of ready mixed paint, the brand of thinner recommended by manufacturer shall be used.

Painting except the priming coat shall generally be taken in hand after all other builder's work is practically finished. The rooms shall be thoroughly swept out and the entire building cleaned up at least one day in advance of the paint work being started. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt scales, smoke and grease shall be thoroughly removed before painting is started.

No painting on exterior or other exposed parts of the work shall be carried out in wet, humid or otherwise unfavourable weather and all the surfaces must be thoroughly dry before painting work is started.

Brushing of Paint:

The brushing operations are to be adjusted to the spreading capacity advised by the manufacturers of the particular paint. The painting shall be applied evenly and smoothly by means of crossing and laying off, the later in the direction of the grain of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternatively in the opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

During painting, every time after the paint has been worked out of the brush bristles or after the brush has been unloaded, the bristles of the brush. (which are drawn together due to the high surface tension) shall be opened up by striking the brush against a portion of the unpainted surface with the end of the bristles held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into the paint container.

Spraying:

Where so stipulated, the painting shall be done with spray. Spray machine used may be (a) high pressure (small air aperture) type or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry conditions prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application with the minimum wastage of paint. The air pressure shall not be kept too high as otherwise the paint will clog up and will be wasted. Spots that are inaccessible to the spray pattern shall be touched up by brush after spraying.

At the end of the job, the spray-gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.

Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved `from the Engineer-in-charge before next coat is started.

Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is applied.

No hair marks from the brush or clogging of paint puddles in the corner panels, angles of moulding, etc. shall be left on the works. In painting doors and windows, the putty round the glass panes shall also be painted but care shall be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

The additional specifications for primer and other coats of paints shall be according to the detailed specifications under the respective headings.

Brushes and containers:
After work, the brushes shall be completely cleaned off paint and linseed oil by rinsing with turpentine. After cleaning, the brushes are wrapped in heavy paper or water proof paper for storage. It is to be used the next day, it shall be hung in a thinner or linseed oil in a container. On no account shall brushes to be made to stand on bristles. A brush in which paint has dried up is ruined and shall on no account be used for painting work.. The containers, when not in use, shall be kept closed and free from air so that paint does not thicken and also shall be kept guarded from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, before they can be used again.

5.2 Wood and wood Based Materials:
Preparation of Surface:

All wood work shall be dry and free from any foreign matter, incidental to building operation.

Nails shall be punched well below the surface to provide a firm key for stopping. Moulding shall be carefully smoothened with abrasive paper and projecting fibres shall be removed. Flat portions shall be smoothened off with abrasive paper used across the grain prior to painting. Any knots, resinous, streaks or bluish sap wood that are large not enough to justify cutting out shall be treated with two coats of pure shellac knotting, applied thinly and extended about 25 mm beyond the actual area requiring treatment.
Plywood and Block Board:

This shall be treated as for solid wood, described above.

Hard Boards:
The surface shall be dusted off and painted with a coat of plastic emulsion paint thinned with water or with a coat of shellac varnish as specified. The surface shall then be rubbed down with fine grade abrasive paper and followed with required under coating and finishing coat as for solid wood.

Particle Board: The surface shall be filled with thin brushable filler and finished as for solid wood.

Insulation Boards: Two thin coats of water based paints shall be applied by spraying.
Priming Coat:

The dirt or any other extraneous material shall be removed from the surface to be painted. In case the surface is already finished with printer coat but unsatisfactory, it shall be rubbed down to bare wood and surface reprimed. Primer shall be applied by brushing.

Application for transparent wood filler:

The filler shall be applied with brush or rag in such a way that it fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours and it shall then be cut and rubbed with emery paper so that the surface of the wood is laid bare, with, the filler only in the pores and crevices of the wood.

Stopping:

All holes, cracks, crevices, etc. shall be stopped carefully to true and level surface with putty before the main undercoat is applied and after the application of the priming coat, stopping shall be prepared as below:

Bees wax, resin and lac (orange in colour) in the proportion of 1: 1: 16 by weight shall be melted down together in a suitable pot using slow heat, the mix being kept well stirred. Colouring materials to produce the required shade shall be added into molten mixture and stirred. Stopping shall on cooling be rolled into stick forms for use.

Application of Paints:

This shall conform to specifications under Para 5. 1 Applying
wood preservatives:

The preservatives of specified quality shall be applied in two coats. On new wood work, it shall be applied liberally with a stout brush and not doubled with rags or cotton waste, The first coat shall be allowed at least 24 hours to soak in before the second coat is applied. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

6.0 WHITE WASHING

General

The item refers to white-washing over old and new concrete, stone masonry brick plastered surfaces and asbestos cement sheets.

White wash shall be prepared from fresh burnt white stone lime or shell lime. This lime shall be of class C type as per IS: 712. Surkhi lime or lime of equivalent quality may be used. The lime shall be dissolved in a tub with sufficient quality of water (about 4.5 litres/Kg. of lime) and the whole shall be thoroughly mixed and stirred until it attains the consistency of thin cream. The white wash shall be taken out in small quantities and strained through a clear course cloth. Alternatively whiting for paints and putty as per IS: 63 may also be used.

Clean gum dissolved in hot water shall then be added in suitable proportion of 2 gm of gum Arabic to a litre of lime or whiting to prevent the white- wash coming off easily

when rubbed. Rice may be used instead of gum. For the new work, the priming coat shall be of white wash with lime or with whiting as specified in the description of the item.

Two or more coats, shall then be applied on the entire surface till it represents a smooth and uniform finish.

The finished dry surface shall not be powdery and shall not readily come off on the hand when rubbed.

Scaffolding:

This may be double or single according to requirements. If ladders are used, pieces of old gunny bags or cloth rags shall be tied on their tops to avoid damage or scratches to the wall. Proper stage scaffolding shall be created when white-washing ceiling. The contractor shall be responsible for accidents if any taken place.

Preparation of Surface:

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means as may be ordered by the Engineer to produce an approved clean and even surface. All loose pieces and the scales shall be scraped off and holes stopped with mortar. In case where the surface has been previously coloured-washed, the old colour wash must be entirely removed before the white-wash is applied. In the case of surface which has once been white-washed, the old loose white-wash shall be broomed down. In case, the loose white-wash cannot be removed by brooming, the Engineer may order scraping of the surface.

After cleaning the surface as specified above, the unwanted nails shall be removed and all nail holes, cracks and crevices stopped with mortar similar in composition to the surface to be stopped. The mortar should be cured.

Application of white-wash:

On the surface so prepared, the white-wash shall be laid. Each coat shall be laid on with a brush. The first stroke of the brush shall be from the top downwards, another from bottom upwards over the first stroke, and similarly, one stroke from the right and another from the left over the first brush before it dries. This will form one coat. Each coat must be allowed to dry and shall be subject to inspection before the next coat is applied. When dry, the surface shall show no signs of cracking. It shall present a smooth and uniform finish free from brush marks and it should not come off easily when rubbed with a finger. No portion in the surface shall be left out initially, to be patched up later on.

For new work, the white washed surface shall present a smooth and uniform finish.

For old work, patches and repairs shall be white washed first. Thereafter, the whole surface shall be white washed with the required number of coats.

Doors, windows, floors and other articles of furniture, etc., shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed and the surfaces cleaned.

Preparing the surface for white wash including the scaffolding. Applying the white wash in required number of coats as specified above and prior white washing of repaired patched.

Mode of Measurement:
Length and breadth shall be measured correct to cm. And shall be calculated in sqm correct to two places of decimals.

Rate
The rate shall include all material and labour involved in all operations described above.

6.0 PLASTIC EMULSION PAINTING ON WALL & CEILING

6.1 General

Plastic emulsion paints are not suitable for application on external wood and iron surfaces and surfaces which are liable to heavy condensation and are to be used generally on masonry or plastered surfaces. Suitable primer as per manufacturer shall be provided.

6.2 Paint

Plastic emulsion paint of approved brand and manufacture and of the required shade shall be used.

6.3 Preparation of Surface

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

6.4 Application

The number of coats shall be as stipulated in the item.
The paint will be applied in the usual manner with brush or roller.
The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine.

Thinning with water will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of thinner to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

6.5 Precautions

(a) Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.

Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

(b) In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

(c) Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

(d) Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeksof application.

6.6 Other Details :

These shall be as per specification for "Painting" as far as they are applicable.

7.0 FLAT OIL PAINT

The work shall include a priming coat of 'Distempering Primer' or 'Cement Primer' as specified in the description of the item. The primer coat shall consist of cement primer or distemper primer as directed by the Engineer in charge.. The primer and the flat oil paint shall be of approved brand and manufacturer and of the required shade. The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for atleast 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on entire surface including filling up the undulations and then sand papering the same after it is dry.

Application:

Primer Coat: The specified primer shall be painted or sprayed over the surface in an even and uniform layer.

Painting Coats: When the surface is dry, it shall be painted or sprayed or as directed by as Engineer-in-Charge with the wall paint in uniform and even layers will be done to the required number of coats. Each coat shall be allowed to dry overnight and rightly rubbed with very fine grade of sand paper and loose articles brushed off before the next coatis sprayed. Spraying should be done only when dry conditions prevail. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application. The air pressure shall not be kept too high as otherwise the paint will fog up and will be wasted.

At the end of the job, the tools and tackles shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns,runs,sags and uneven coats.

If after the final coat of wall paints, the surface obtained is not upto the mark, further one or more coats as required shall be given after rubbing down the surface and dusting of all loose particles to obtain a smooth and even finish. If the primer or wall paint gets thicker during the application, it shall be thinned suitably with the thinner recommended by the manufacturer.

Adequate ventilation shall be provided to avoid congestion and discomfort. Fitments and floor shall be suitably protected.

8.0 SYNTHETIC TEXTURED PAINT IN PLAIN / STONE OR METALLIC FINISH.

8.1 General

Synthetic Textured Paint, reinforced by using fibres and shall be based on chemicals having acid and alkally resistant properties. It can be applied to any hard, plain surface both internally and externally. It does not require any further application or treatment once it is applied on the surface.

Synthetic Textured Paint is available in ready-mixed form in any desired colour and can be applied by using a trowel. The synthetic Textured Paint avoids cracks formation as well as it provides a waterproofing coating on the surface treated.

8.2 Base Coat

An average 20mm thick cement plaster shall be provided as rendering coat which shall be roughened lightly with wire brush so as to form very mild keys on the rendered surface. The surface shall be allowed for curing for a period of minimum 14 days before the application of synthetic Textured Paint.

8.3 Applications

Synthetic Textured Paint is applied in three coats :

(a) one coat of plaster by trowel and ;

(b) subsequent two coats of chemical overcoat by brush in approved colour and finished as specified (plain/stone or metallic).

8.4 Measurements

The item shall be measured in square metre areas. The rate shall include erecting and removal of scaffolding, all labour, materials, equipments, plants, tools and all incidental expenses to complete the treatment to the satisfaction of Engineer-in-charge.

8.5 Guarantee

The synthetic Textured Paint treatment shall be executed through an approved agency and written performance guarantee shall be submitted by the Contractor for a minimum period of Ten years through the agency. The contractor and the agency shall be jointly responsible for the performance of the treated surface until the expiry of the guarantee period.

10.0 ACRYLIC PAINTING TO EXTERNAL SURFACES

Acrylic weather shield paint of approved brand shall be applied over plastered surfaces as directed by the Engineer.

Other specifications including preparation of surfaces, application of paint etc. shall conform to section 4.3 above and as directed by Engineer-In-Charge. The priming coat, anti-fungal treatment, preparation of paint etc. shall be carried out as per manufacturer's specification / as directed by Engineer-In-Charge.

11.0 MEASUREMENT

Painting on plastered or concrete surface shall be measured as for plastering. Painting on wooden or metal surfaces shall not be measured separately and is deemed to be included in the respective item.

FLOORING, SKIRTING, DADO & CLADDING

SI NO	DESCRIPTION
1.0	Scope
2.0	General
3.0	Material
4.0	Sub base
5.0	Cement Concrete Flooring
6.0	Glazed / ceramic tiles in flooring
7.0	Glazed / Ceramic tiles in dado / skirting
8.0	Marble / Granite stone slab flooring
9.0	Marble / Granite stone in Risers / Steps / Skirting
10.0	Marble / Granite stone slab cladding
11.0	Vitrified Tiles for Flooring
12.0	Wooden Laminated Flooring
13.0	Paver block flooring

1.0 SCOPE

These Specifications covers flooring, skirting, dado or cladding works using different types of stone/ slabs/ tiles as detailed hereunder:

2.0 GENERAL

The provision of the latest revisions of the following IS Codes shall form a part of this specification to the extent they are relevant.

IS: 269 Specification for ordinary, rapid hardening and low beat Portland cement.
IS: 383 Specification for coarse and fine aggregate from natural sources for concrete
IS: 657 Specification for material for use in the manufacturer of magnesium oxychloride flooring compositions.
IS: 1130 Specification for marble (Blocks, slabs & Tiles).
IS: 1200 Part XI Method of measurements for Building and Civil Engg. Works, paving, floor finishes, dado & skirting.
IS: 1237 Specification for cement concrete flooring tiles.
IS: 1443 Code of practice for laying and finishing of cement concrete flooring tiles.
IS. 2541 Code of practice for use of lime concrete' in buildings.
IS: 2571 Code of practice for laying in situ cement concrete flooring
IS: 4082 Recommendation on stacking and storage of construction materials at site.
IS: 4457 Specification for Ceramic unglazed vitreous acid resistant tile.
IS: 8042 Specification for white port land cement
IS 8112 Specification for high strength ordinary portland cement
IS: 10067 Material Constants in Building Work
IS: 13711 Ceramic Tiles : Sampling & basis of acceptance
IS: 13712 Ceramic Tiles : Definitions, classifications, characteristics and making IS: 13753 Dust Pressed ceramic tiles with water absorption of E > 10% (Group - B III)
IS: 13754 Dust Pressed ceramic tiles with water absorption of 6% < E < 10% (Group - B IIb)
IS: 13755 Dust Pressed ceramic tiles with water absorption of 3% < E < 10% (Group - B IIa)
IS: 13756 Dust Pressed ceramic tiles with water absorption of E < 3% (Group - B I)
Other I.S Codes not specifically mentioned here, but pertaining to Floor Finishes form part of these specifications.

3.0 MATERIAL

3.1 Cement, sand, aggregate, water shall conform to the relevant BIS standards as specified in clause 2.0 above.

Stone shall be hard, sound, durable and free from defects like cavities, cracks, sandholes, flaws, injurious veins, patches of loose or soft materials and weathered portions etc.

4.0 SUB-BASE

4.1 Sub-base for all flooring shall be prepared and kept ready for further applications. All items shall be defined and detailed on the drawing. Measurements shall be as per the BOQ of these items.

Preparation of sub-base may be carried out by excavation or back filling in plinth. Back filling shall be with the selected earth in layer of 150mm to 200mm maximum and adequately watered and well-compacted to achieve at least 90% compaction at optimum moisture content.

In case of excavation, the base shall be well-dressed to the desired level and inspected. All loose spots shall be excavated till the hard surface is reached and then filled as directed by the Engineer-in-Charge. Surface shall be watered with just sufficient water and rolled and compacted with vibratory compactor.

4.2 Dry Brick Flooring

4.2.1 Spreading Sand:-

After the plinth has been prepared as detailed above, 225mm of sand shall be spread, evenly over the surface and well watered and the wet sand brought to a true under surface formation.

4.2.2 Laying bricks:-

Over the sand, thoroughly well burnt bricks of uniform shape shall be laid on edge breaking bonds in straight lines. After laying each two or three lines of bricks, they shall be cramped together as tightly as possible. When the last line of bricks has been cramped into position no movement of the bricks should be possible and if any such exists, the flooring must be removed and railed.

4.2.3 Blinding the surface:-

After the bricks are satisfactory laid, sand will be spread over the surface so as to fill all joints. This sand will be well watered and more sand and water added as necessary and until all joints are filled flush and solid.

4.2.4 Pointing:-

The joints shall there after be raked out to a depth of half an inch and level pointed with cement mortar.

4.2.5 Curing:-

The complete work shall be kept covered with wet straw for ten days after pointing.

4.3 Rubble soling

Good quality 150mm to 230mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100mm for 150mm thick soling and

150mm for 230mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes, pegs at suitable intervals (about 12m) shall be fixed.

Soling shall be watered and again packed with sand or stone dust to fill interstices created by watering. Then it shall be rolled by power driven roller of 10MT capacity wherever possible or with vibratory compactor. Filling sand or stone dust, watering and compaction shall continue till full compactness is achieved to the satisfaction of the Engineer-in- Charge.

4.4 Base floor

This shall be regular reinforced concrete floor or plain cement concrete floor as specified. All specifications of concreting shall be the same as per Plain & Reinforced Concrete section of this volume.

5.0 CEMENT CONCRETE FLOORING

5.1 Materials

Cement concrete: The cement concrete shall generally conform to specifications for ordinary concrete. The coarse aggregates shall be carefully selected, sufficiently tough and hard stone pieces broken in a manner that will provide particles of approximately cubical shape affording good interlocking. The maximum size of coarse aggregate shall be 12 mm.

The fine aggregate shall consist of properly graded particles. The proportion of mix shall be as specified in the item description. The least amount of mixing water that will produce a workable mix and will allow finishing without excessive trowelling shall be used. Generally a water cement ratio of 0.5 should suffice.

5.2 Workmanship:

The sub-grade in all cases shall be formed to proper levels and slopes, well compacted and cured. The top surface shall be kept slightly rough. The surface of the sub-grade shall be cleaned off all loose materials and moistened immediately before laying the concrete floor. The concrete flooring shall be laid in alternate bays not exceeding 3.35 sq.m (about 36 sf.ft) each. The edge of each panel into which the floor is divided should be supported by aluminium dividing strips of adequate size to prevent sticking. Their depth shall be the same as that proposed for the finished floor as mentioned in the item. At least 48 hours shall elapse before the concreting in the adjacent bays is commenced.

The concrete shall be laid immediately after mixing. While being placed the concrete shall be vigorously sliced and spaded with suitable tools to prevent formation of voids or honey comb pockets. The concrete shall be brought to the specified levels by means of a heavy straight edge resting on the side forms and drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with small lateral shifts. While concreting the adjacent bays care shall be taken to ensure that the edges of previously laid bays are not broken by careless or hard tamping.

Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or removing the concrete. After striking off the surfaces to the required grade concrete shall be compacted with a wooden float. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given to complete the ramming. The floating shall be followed by steel trowelling after the concrete has hardened sufficiently to prevent excess of fine material from working to the surface, The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix. After the concrete has been thoroughly rammed and has dried sufficiently to allow rendering to be worked up, surface shall be rendered with a thin coat of 1:1 cement mortar with fine sand and uniformly floated. If so directed by the Engineer-in-Charge, approved mineral colour pigment conforming to appendix-B of IS 657 shall be added to the cement mortar to give the required colour and shade to the flooring. When the cement mortar rendering is sufficiently stiff, lines shall be marked on it with strings or by any other device to give the appearance of tiles 30 x 30 cm or of any other size laid diagonally or square as directed by the Engineer-in-Charge. The junctions of floor and walls shall be rounded off if so directed, without any extra payment.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge. Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

Finishing: When the rendering is somewhat stiff, neat cement may be sprinkled on sparingly through a paper pot on the surface and rubbed lightly to give smooth polished ordinary cement coloured surface. If coloured flooring is required by the Engineer-in-Charge the approved coloured cement shall be used. Surface shall be protected from direct sun when it is green.

Curing: Curing shall start on the next day after finishing and shall be continued for 14 days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remanents of cement dust from the bags.

5.3 Measurement -

Length and breadth shall be measured before laying skirting dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm. The flooring done either with strips (in one operation) or without

strips (in alternate panels) shall be treated as same and measured together.

5.3.1 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on RCC slab or on base concrete including roughening and cleaning the surface and including the cost of strips. Nosing of steps where provided shall be paid for separately in running metre. Nothing extra shall be paid for laying the floor at different levels in the same room or courtyard and rounding off edges of sunken floors. In case the flooring is laid in alternate panels, nothing extra shall be paid towards the cost of shuttering used for this purpose.

6.0 GLAZED / CERAMIC TILES IN FLOORING

6.1 Material

The tiles including specials shall be of the approved make and quality and shall conform to BIS Specifications in all respects. Glazed tiles / Ceramic tiles shall conform to IS : 13711-1993, IS : 13712-1993, IS : 13753-1993, IS : 13754-1993, IS : 13755-1993, and IS : 13756-1993. Samples of tiles shall be got approved by the Engineer-in-Charge, who will keep them in his office for verification as to whether the material brought for use conform to the approved samples.

The tiles shall be square or rectangular of size as specified in the item description or as directed by the Engineer-in-charge. The thickness of the tiles shall be as specified. The length of all four sides shall be measured correct to 0.1mm and average length breadth shall not vary more than ± 0.8mm from specified dimension. The variation of individual dimension from average value of length / breadth shall not exceed ± 0.5mm. Tolerance in thickness shall be ± 0.4mm. Cement Mortar 1:4 to be used along with White Cement of approved quality and make.

6.2 Workmanship

6.2.1 Mortar Bedding

The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in the preparation of mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed, the base shall be cleaned of all dirt, scum or laitance and loose materials and then well wetted without forming any pools of water on the surface.

The mortar shall then be evenly and smoothly spread over the base by the use of screed battens to proper level or slope. The thickness of the bedding shall not be less than 12 mm (about 1/2") or more than 20 mm (about 3/4") in any one place. The tiles shall be laid on bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles.

6.2.2 Fixing Tiles

The tiles before laying shall be soaked in water for at least 2 hours. Tiles, which are fixed in the floor adjoining the wall, shall be so arranged that the surface of the round edge tiles shall correspond to the skirting or dado. Neat cement grout of honey like consistency shall be spread over the bedding mortar just to cover so many areas as can be tiled within half an hour. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight lines. The joints between the tiles shall not exceed 1. 5 mm (about 1/ 1 6") wide. The joints shall be grouted with a slurry of white cement. When hairline joints are specified the same shall be followed. After fixing the tiles finally in an even plane, the flooring laid shall be kept moist and allowed to mature undisturbed for 10 days to allow the bedding and flooring to set properly.

6.2.3 Cleaning

After the tiles have been laid in a room or the day's fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, the floor shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after completion of the construction work and just before the floor is occupied.

6.3 Measurements

Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster and the area calculated in square metre correct to two places of decimal. Where coves are used at the junctions, the length and breadth shall be measured between the lower edges of the coves.

No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre.

Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Areas, where glazed tiles or different types of decorative tiles are used will be measured separately.

6.4 Rate

The rate for flooring shall include the cost of all materials and labour involved in all the operations described above. Nothing extra shall be paid for the use of cut (sawn) tiles in the work.

7.0 GLAZED/CERAMIC TILES IN DADO/ SKIRTING

7.1 Materials

The tiles including specials shall be of the approved make and quality and shall conform to BIS standards in all respects. Samples of tiles shall be got approved by the Engineerin-Charge. Materials brought for use shall conform to the approved samples.

7.2 Workmanship

7.2.1 Plastering

Cement plaster of about 15 mm thickness shall be applied to the part of the wall where

dado or skirting is to be fixed. The proportion of mortar shall be as mentioned in the item.

7.2.2 Fixing of Tiles

Dado or skirting work shall be done only after fixing tiles on the floor is completed. The tiles shall be soaked in water for at least 2 hours before being used for skirting or dado work. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff. The back of tiles shall be covered with a thin layer of neat cement paste and the tile shall then be pressed in the mortar and gently tapped against the wall with a wooden mallet. The fixing shall be done from the bottom of wall upwards without any hollows in the bed or joints. Each tile shall be fixed as close as possible to the one adjoining. The tiles shall be joined with white cement and matching coloured pigment slurry. Any difference in the thickness of tiles shall be evened out in cushioning mortar so that all tile faces are in one vertical plane. The joints between the tiles shall not exceed

1.5 mm in width and they shall be uniform. After fixing the dado, they shall be kept continuously wet for 14 days.

7.2.3 Cleaning

After the tiles have been fixed the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing, the dado or skirting work shall be washed thoroughly clean.

7.3 Measurement

Flooring shall be measured in Square Metres correct to two places of decimal while the individual dimensions shall be measured correct to one centimetre before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for any opening of area up to 0. 1 sqm. Nothing extra shall be paid for use of outlines nor for fixing at different levels. Risers of steps, skirting, cladding and dado shall be measured in square metres correct to two places of decimal. Length shall be measured in centimetre along finished face of the riser, skirting, cladding or dado correct to a centimetre. Height shall be measured from the finished level of tread or floor to the top.

7.4 Rates

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

8.0 MARBLE / GRANITE STONE SLAB FLOORING

8.1 General

The item refers to provision of flooring of Indian Marble / Granite stone slabs of approved colour / pattern and shall conform to the specification as given below :- 8.2 Materials

8.2.1 Stone Slabs

The stone slab specified in the item shall be got approved by the Engineer. At its thinnest part, no stone shall be thinner than the specified thickness. The stone slab shall be hard, sound, durable, resistant to wear, rectangular in shape or square if directed by the

Engineer and of the specified width. The stone slab shall be of the type mentioned in the item and of the colour and quality approved by the Engineer. Slabs shall be hard, dense, uniform and homogenous in texture. They shall have even crystalline grain, and free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine cut true and square. The rear face shall be rough enough to provide a key for the mortar. Uniformity of size shall generally be maintained for the stone slab used in any room. The stone shall be without any soft veins; cracks of floors and shall have a uniform colour. The edges shall be quite straight. The stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used. Samples of stone slabs to be used shall be got approved by the Engineer and the slabs to be used shall conform to the approved sample. The dimensions of the slab shall be as specified in the item.

8.2.2 Approval of Sample

Before starting the work, the contractor shall get samples of marble / granite slab approved by the Engineer-in-Charge. Approved samples shall be kept in the custody of the Engineer-in-Charge and the marble / granite slab supplied and used on the work shall conform to samples with regard to soundness, colour, veining and general texture.

8.2.3 Sampling

In any consignment of marble / granite, all the blocks / slabs / tiles of the same group, size and finish shall be grouped together to constitute a lot. Sample shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification. The number of marble / granite blocks / slabs / tiles to be selected for the samples shall depend upon the size of the lot and shall be in accordance with the Table (Sample size & Criteria for conformity) given below:

8.2.4 Sample size and Criteria for Conformity.

Number of Blocks /slabs /tiles in the lot	Number of blocks slabs / Tilesto be selected in sample	Permissible number of defectives	Sub sample size in Nos.
Upto 25	3	0	2
26 to 100	5	0	2
101 to 200	8	0	3
201 to 500	13	0	4
501 to 1000	20	1	5

Note: The marble / granite blocks/ slabs/ tiles in the sample shall be taken at random and in order to ensure to randomness of selection, random tables may be used.

Explanation 1: All the marble / granite blocks / slabs / tiles, selected in the sample, shall

be examined for dimensions workmanship and general requirements. Any block / slab / tile failing in any one or more of the above requirements shall be considered as defective. All lot shall be considered as conforming to these requirements if the number of defectives obtained is not more than permissible no. of defectives given in Col. 3 of the Table.

Explanation 2: The lot of marble / granite having been found satisfactory with respect to dimensions, workmanship and general requirements shall be tested for physical properties as given below. For this purpose a sub sample of the size given in Col. 4 of table shall be selected at random. These marble / granite blocks/ slabs / tiles in the sub sample shall be tested for moisture absorption, hardness and specified gravity. The lot shall be considered having satisfied the requirements of the physical properties if none of the marble / granite blocks / slabs / tiles tested for the requirements fails in any of these tests.

Physical Properties

SL NO	CHARACTERISTIC	STANDARDS	METHOD OF TEST
01	02	03	04
01	Moisture absorption after 24 hrs immersion in cold water	Max. 0.4% by weight	IS : 1124
02	Hardness	Min 3 Mohs	Mhos Scale
03	Specific Gravity	Min 2.5 g/cc	IS : 1122

8.2.5 Bedding

Cement mortar for the bedding shall be of the proportions as specified in the item. The proportions will be by volume on the basis of 50 Kg. bag of cement. The mortar may be hand mixed or machine mixed.

In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Fresh & clean water shall be added gradually and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes. The mortar remaining unused after that period or mortar which has partially hardened or is otherwise damaged shall not be retempered or remixed. It shall be destroyed or thrown away.

8.3 Construction

8.3.1 Bedding

The base of cement concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and below the level of the finished floor to the

extent of the thickness of the slabs and mortar bedding. Cement concrete bedding if provided shall be paid under a separate item. Cement mortar for bedding may be mixed manually or by a mechanical mixer. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Care shall be taken in preparing the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stones. Before spreading the mortar, the sub-floor or base shall be cleaned of all dirt, scum or laitance and of loose material and then well wetted without forming any pools of water on the surface. In case of R.C.C. floors, the top shall be left a little rough. All points of level for the finished paving surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with slabs within half and hour. The thickness of the mortar bedding shall not be less than 12mm, not more than 25mm. The required slope shall be given to the bed.

8.3.2 Fixing stone slab

Before laying, the stone flags shall be thoroughly wetted with clean water. Neat cement grout of honey like consistency (white cement shall be used in the case of marble slabs) shall be spread on the mortar bed over as much area as could be covered with the slabs within half an hour. The specified type of stone slabs shall be laid on the neat cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each stone slab shall be gently tapped with a wooden mallet till it is firmly and properly bedded. There shall be no hollows left. If there is a hollow sound on gentle tapping of the slabs, such slabs shall be removed and reset properly. The Mason shall make the joints of uniform thickness and in straight lines. The joints shall be filled solidly with pigmented grout for their full depth. The stone slabs shall be laid so as to give continuous parallel long joints with cross joints at right angles to them. The edges of the adjoining slabs shall be in one plane. Where the slabs cover open edges, of floor or window sills the edges shall be neatly rounded off. This shall be included in the rate.

When diamond pattern paving is provided in the item, the slabs shall be square and laid to the diamond pattern with triangular shaped slabs to make up the edges. In plain pattern stones on each course shall break joints with those in the next. The pattern joints etc. shall be as per drawings or as directed by Engineer-In-Charge, to the entire satisfaction of Engineer –In- Charge

8.3.4 Curing

The flooring shall be kept well wetted with damp sand or water for fourteen days. It shall be kept undisturbed for at least seven days.

Cleaning

All flooring shall be thoroughly cleaned and handed over clean and free from any mortar stains etc.

8.4 Measurement:

The contract rate shall be per square metre of the floor area covered by the flooring of the specified type. All work shall be measured net. The length and width of the flooring shall be measured net between the faces of skirtings or dados or plastered faces of walls.

Paving under the dado, skirting or plaster shall not be measured.

8.5 Rate :

The rate for the item shall include the following.

(a) All labour, materials and equipment, cleaning the sub-base, laying mortar bed and cement grout, fixing stone slabs specified above and making up the joints.

(b) Any cutting and waste if required.

(c) Pointing when included in the item.

(d) Cleaning the floor from all stains, etc.

(e) Polishing wherever required.

9.0 MARBLE / GRANITE STONE IN RISERS OF STEPS AND SKIRTING

9.1 Marble Stone Slabs and Dressing of Slabs shall be as specified above in clause 10.0 of Marble / Granite Stone Slab Flooring except that the thickness of slabs shall be as specified in the item description. A tolerance of + 3mm shall be allowed, unless otherwise specified in the description of the item.

9.2 Preparation of Surface

It shall be as specified above in clause 10.0 of Marble / Granite Stone Slab Flooring except where necessary the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge.

9.3 The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12mm and at no place the width shall be less than 10mm. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement: 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength. The joints shall be as fine as possible. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched as shown in drawings or as instructed by the Engineer-in-Charge.

9.4 Curing, Polishing and Finishing

The face and top of skirting shall be polished. The stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. “00” up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used

9.5 Measurements

Length shall be measured along the finished face of riser or skirting, correct to a cm. Height shall be measured from the finished level of tread or floor, to the top (the underside of tread, in the case of steps) correct to 1mm. The areas shall be calculated in square metre correct to two places of decimal.

9.6 Rate

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

10.0 MARBLE / GRANITE STONE SLAB CLADDING

Marble / Granite tiles and slabs shall be mirror polished, flame finished or as given any other surface treatment as specified. All exposed edges shall be similarly treated. The Marble / Granite stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used Machine polishing and sizing shall be done with only water as lubricant. Sawing also shall be preferably done with water as lubricant but as a special case, oil or kerosene may be permitted subject to the oil or kerosene being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise shall be rejected. Any tiles / slabs showing patches or stains after installation shall also be rejected and replaced.

Tiles shall be transported to site well-packed in boxes. Slabs will be individually packed in cardboard paper. Tiles / slabs shall not be waxed or touched up with dyes / colours. The entire supply for each type of marble / granite, unless specifically permitted by the Consultant, shall be procured from one location in one quarry to keep variations to the minimum. The Contractor shall segregate and sort the tiles / slabs according to colour, texture and size to keep variations in the same in any one floor, wall or isolated area to the minimum. The Contractor shall, before fixing the marble / granite on floors or walls, lay whole areas of marble / granite loose on ground to select and match the marble / granite.

Any tiles / slabs with a variation not acceptable to Consultant / ENGINEER shall not be used, and if used shall be removed and replaced. The Consultant's decision in this respect shall be final and binding. Tight tolerances shall be checked and maintained throughout. Maximum variations shall be as follows:-

Sides	± 0.5 mm
Thickness	± 0.5 mm slabs
	± 0.3 mm tiles
Angularity	± 0.2 %
Flatness	± 2 mm

Linear items such as treads, skirting, sills etc. shall be of uniform thickness throughout. All visible edges shall be machine polished unless otherwise specified.

Marble / granite shall be laid or fixed to the highest standard by highly trained masons to the entire approval of Consultant / Engineer. Any tiles / slabs broken, stained or damaged shall be removed / replaced.

External wall cladding shall be fixed with approved stainless steel 316 grade serrated cramps and dowels. Marble / granite slabs for external cladding shall be minimum 30mm thick. The Contractor shall prepare shop drawings and get them approved by the Consultant before proceeding with any work.

The Contractor shall put a mock-up of typical and non-typical panels and get it approved well before he commences fixing on site. The Contractor shall coordinate his site activities with other contractors working on site through Engineer and shall take particular care, in coordination with the Engineer, in ensuring that his methods of fixing do not damage or endanger the building structure, finishes and services in any way. The Contractor shall get his system of anchorage approved by the Consultant. No reinforcement bar in concrete shall be cut through during drilling or anchorage.

The anchorage in solid concrete blockwork shall be specially designed taking into consideration the actual compactness and crushing strength of the blocks. 2 nos. pullout tests in blockwork shall be carried out prior to commencing work to prove the strength of anchorage with ample margin of safety.

Prior to commencing work, the Contractor shall obtain approval of the Consultant for material and workmanship after submitting the following details:- (a) 3 representative samples for each type of marble / granite specified.

(b) Physical characteristics:-

Dimensional tolerances, water absorption (polished or unpolished as applicable) by weight, compression strength, Mohs hardness, unit weight.

(c) Source of supply and availability in full quantity and uniformity of colour, tone and texture.

(d) Company profiles of suppliers and labour sub contractor if any.

(e) Procedure for fixing and samples of fixtures such as cramps, pins, dowels etc. If required the Contractor shall arrange visits to the quarries and to the works carried out by the proposed Sub Contractor.

10.1 Measurements:

The length and breadth shall be measured correct to a cm. In case of radially dressed or circular slabs used in the work, the dimensions of the circumscribing rectangles of the dressed stone used in the work, shall be measured & paid for. The area shall be calculated in Sqm. nearest to two paces of decimal.

10.2 Rate:

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

a) Marble / Granite stone slab / tiles procured & delivered at Site, including wastage and breakage, polishing, chamfering, rounding, grooves, drip moulds and other linear works as per drawings and specifications.
b) Stainless steel cramps, pins, dowels and other anchoring systems as per approved shop drawings and as specified.
c) Backing mortar and pigmented cement grout where specified.
d) Labour in transporting materials on site, fixing, carefully cutting, hand polishing, and touching up where required etc.
e) Protecting Marble / Granite stone slab / tiles during construction until virtual completion of works.
f) Temporary supports, templates, straight edges etc.
g) Alignment and leveling in coordination with Engineer and Main Contractor.
h) Joints with plastered and other surfaces.
i) Cleaning on completion.
j) Scaffolding / staging and safety precautions.
k) Submissions of Samples.
l) Mock-up (total area approx. 15 sqm.)
m) Working to specified tolerances
n) Shop drawings
o) Pull out tests – 2 nos. – on anchors in blockwork.
p) Provisions for adequate anchorage.
q) Providing and applying protective water / stain resistant chemical coating / impregnation treatment.

11.0 VITRIFIED TILES FOR FLOORING

11.1 Standards

DESCRIPTION	MINIMUM REQUIREMENT
Specification for coarse and fine aggregates	I.S. 383 - 1970
Tests for mortar	I.S. 2250 : 1981
Method of test of aggregates in concrete	I.S. 2386 - 1963
Recommendation on stacking and storage of construction materials at site.	I.S. 4082 : 1996
Specification for white port land cement	I.S. 8042 - 1989
Ordinary portland cement 43 grade	I.S. 8112 - 1989
Water	I.S. 456 : 2000 & I.S. 3025

Vitrified Tiles	Shall conform to EN - 176 Group B1a and ISO 13006 stds.
Deviation in length	Method of testing shall be as per EN 98
Deviation in thickness	Method of testing shall be as per EN 98
Straightness of sides	Method of testing shall be as per EN 98
Rectangularity	Method of testing shall be as per EN 98
Surface flatness	Method of testing shall be as per EN 98
Water absorption	Shall not be greater than 0.05 % (Method of testing shall be as per EN 99)

Moh's hardness	Shall not be less than 6 (Method of testing shall be as per EN 101)
Flexural strength	Shall not be less than 27 N / sqmm. (Method of testing shall be as per EN 100)
Abrasion resistance	(Method of testing shall be as per EN 102)
Skid resistance (coefficient of friction)	0.6 (Method of testing shall be as per ASTM C-1028)
Breaking strength	Shall not be less than 2500 N (Method of testing shall be as per ASTM C-678)
Density	Shall not be less than 2 gm / cm3 (Method of testing shall be as per DIN - 51082)
Frost resistance	Shall be frost proof (Method of testing shall be as per EN - 202)
Chemical resistance	Shall be resistant to chemicals(Method of testing shall be as per EN - 106)
Thermal shock resistance	Shall be resistant to thermal shocks (Method of testing shall be as per EN - 104)
Colour resistance	No damage (Method of testing shall be as per DIN - 51094)
Thermal expansion	Shall not be more than 9 x 10-6 (Method of testing shall be as per EN - 103)
Stain resistance	Shall be stain resistant (Method of testing shall be as per ISO 10545 -14)
Glossiness	Desired reflection effect as required by architect (Method of testing shall be with the
	use of glossometer)

11.2 Materials Tiles

The tiles shall be unchamfered, fully vitrified, homogeneous, unglazed, ceramic satin matt finished tiles of nominal size of premium quality. The size and thickness of tiles shall be as per the architectural requirements.

11.3 Workmanship

The floor tiles shall be laid to the correct slope and levels. The mix of the mortar shall be to a minimum of 1:4 consistency.

Bedding for tiles in flooring

The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Before spreading the mortar bed, the base shall be cleaned of all dirt, scum or laitance and loose materials and then well wetted without forming any pools of water on the surface. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens to proper level or slope. The thickness of the bedding shall not be less than 12 mm (about 1/2") or more than 20 mm (about 3/4") in any one place.

The tiles shall be laid on bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles.

Laying of tiles

The tiles before laying shall be soaked in water for at least 2 hours. Tiles, which are fixed in the floor adjoining the wall, shall be so arranged that the surface of the round edge tiles shall correspond to the skirting or dado. Neat cement grout of honey like consistency shall be spread over the bedding mortar just to cover so many areas as can be tiled within half an hour.

The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight lines The joints between the tiles shall not exceed 1. 5 mm wide. The joints shall be grouted with a slurry of white cement. After fixing the tiles finally in an even plane, the flooring shall be covered with wet saw dust and allowed to mature undisturbed for 14 days.

Cleaning

After the tiles have been laid in a room or the day's fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, the floor shall be carefully washed clean and dried.

11.4 Testing

If any tile is found to be warped, damaged or irregular in shape and size, it shall be refitted or replaced, properly jointed. The tiling work shall be tested for plumb, line and level. The surface of the floor and wall surfaces shall be frequently checked with a straight edge.

Corners of walls shall be truly at right angles. The finished work shall not sound hollow when tapped with a wooden mallet.

11.5 Measurement:

The contract rate shall be per square metre of the floor area covered by the flooring of the specified type. All work shall be measured net. The length and width of the flooring shall be measured net between the faces of skirting or dados or plastered faces of walls. Paving under the dado, skirting or plaster shall not be measured.

11.6 Rate :

The rate for the item shall include the following.

(a) All labour, materials and equipment, cleaning the sub-base, laying mortar bed and cement grout, fixing tiles as specified above and making up the joints.

(b) Any cutting and waste if required.

(h) Pointing when included in the item.

(c) Cleaning & protecting the floor from all stains, etc.

12.0 WOODEN LAMINATED FLOORING

12.1 Standards

DESCRIPTION	MINIMUM REQUIREMENT
Usage	Method of test shall be as per EN 13329
Wear resistance	As per EN 13329

Impact Resistance	As per EN 13329
Stain resistance	As per EN 13329
Cigarette burns	As per EN 13329
Colour fastness	As per EN 13329
Slip resistance	Shall not be less than 0.60 (As per ASTM C 1028)
End joint displacement	A minimum of 200mm between joints shall be maintained
Indentation resistance	Shall not be less than 600 kg / sqcm. (As per DIN 52185)
Electrostatic charge	0.9 kV (As per DIN 54345)
Formaldehyde emission	As per EN 717 - 2
Fire resistance	B1 (As per DIN 4102)

12.2 Materials Laminate flooring

The laminate flooring shall be of first quality and shall adhere to all the relevant international or equivalent Indian standards. It shall be of approved shade, make, design and quality and shall be laid in a pattern / layout as per the specific requirements of the architect. The flooring planks shall be hard, durable and shall require minimal maintenance.

12.3 Workmanship

Laying of floor

The floor shall be installed at room temperature strictly as the guidelines prescribed by the manufacturer. The floor may be installed as a floating floor at the discretion of the Engineer. The sub floor shall be dry, rigid, even and clean. Care shall be taken to ensure that the floor is not laid in wet rooms or in rooms provided with floor drains.

A polyethylene film of minimum 0.2 mm thickness shall be provided as a moisture barrier over the sub floor prior to laying the laminate flooring. The contractor shall ensure to provide a gap of about 12 to 15mm from all the walls and fixed objects to allow for the flooring to settle in the environment. The plank profiles shall be fixed securely into the sub floor.

An approved flexible sealant made out of acrylic or polyurethane shall be used for fixing the flooring. The entire expansion space shall not be filled. The planks shall be installed lengthwise, parallel to the side walls in small corridors and passages. The planks shall be fixed preferably in a direction towards incoming light. The top layer shall be of polyurethane type finish in order to maintain the aesthetics of the flooring.

12.4 Protection & Maintenance

Whenever glue is used for fixing, the excess glue during fixing shall be removed immediately with a scraper and damp cloth. A constant indoor room climate of 40 to 60 % RH, shall be ensured at the time of installation. No furniture or any other heavy object should be dragged on the floor after installation. The flooring shall be cleaned with an upright vaccum cleaner or a damp cloth and a dry broom. Steam cleaners shall not be used. The floor shall not be sanded, waxed, lacquered or treated with film forming agents or abrasive materials.

12.5 Testing

The testing for various properties shall conform to the various international standards as listed in standards above. The flooring after installation may be tested for straightness and evenness using a straight edge. If any undulations are noticed, the same may be rectified complete to satisfaction of the Engineer

12.6 Measurement:

The contract rate shall be per square metre of the floor area covered by the flooring of the specified type. All work shall be measured net. The length and width of the flooring shall be measured net between the faces of skirting or dados or plastered faces of walls. Paving under the dado, skirting or plaster shall not be measured.

12.7 Rate :

The rate for the item shall include the following.

(a) All labour, materials and equipment, cleaning the sub-base, installation of the flooring including all operations as mentioned above.

(b) Any cutting and waste if required.

(c) Cleaning & protecting the floor from all stains, etc.

13.0 PAVER BLOCK FLOORING (WITH SAND BEDDING)

13.1 Scope

Scope of work consisting of providing and laying of Paver block of required size, shape and colour as per the specification given below.

13.2 Dimension And Tolerances:

Paver blocks shall be as per specified size, thickness, colour and quality as approved by the Architect. Maximum variation in dimension of paver block shall not be more than + 2 mm.

13.3 Testing & Sampling

The testing and sampling shall be carried out as directed by the Engineer-in-charge / PMC.

13.4 Manufacturer's Certificate

The manufacturer shall satisfy that the paver block conform to the requirement of this specification and shall produce certificate to this effect along with each consignment.

13.5 Independent Testing

If the Engineer-In-Charge / PMC desires to carry out tests pertaining to quality, size, strength etc. the same shall be carried out by selecting random sample from any batch. The manufacturer shall supply free of charge required number of paver block for testing. Cost of testing shall be borne by the manufacturer.

13.6 Laying & Fixing Paver block

The base on which the blocks are to be laid shall be cleaned, wetted and mopped. The bedding for the paver block shall be with 50mm sand bed. The average thickness of the bedding mortar under the paver block shall be 50 mm and the thickness at any place under the paver block shall be not less than 50mm. The paver block shall be laid in the following manner:-

Sand of the specified thickness shall be spread under the area of each paver block roughly to the average thickness specified above. The paver block shall be washed clean before laying. They shall be laid on top, pressed, vibrated with plate vibrator and brought to level with the adjoining block. The paver block shall be lifted and laid aside. The top surface of the sand shall then be corrected by adding fresh sand at hollows. The paver block shall then be lowered gently back in position and vibrated with plate vibrator till they are properly bedded in level with and close to the adjoining blocks with as fine a joint as possible. Subsequent block shall be laid in the same manner. After each block has been laid, surplus sand on the surface of the block shall be cleaned off. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer- inCharge / PMC.

13.7 Rate

The rate shall include all labour, materials, tools and tackles required for the following tasks to carry out the item as specified above.

i) Providing and fixing the paver block in the required pattern ii)
Cleaning the floor before and after the paver block has been laid.

13.8 Mode of Measurement

Laying of paver block shall be measured in square metres correct to two places of decimal while the individual dimensions shall be measured correct to one centimetre. No deduction shall be made nor extra paid for any opening in the floor area upto 0. 1 sq.m. Nothing extra shall be paid for use of outlines / pattern nor for laying the floor at different levels in the same area.

FALSE CEILING

CONTENTS

1.0 PLASTER OF PARIS (GYPSUM ANHYDROUS) TILES CEILING

1.1 INDIAN STANDARDS

(1) IS : 2095 – 1982 : Gypsum Plaster boards.

The above mentioned IS Specification and Code of Practice has been indicated for general guidance.

However, this IS Specification and Code will be adopted only for those particular items in the contract where the mode of measurement or detailed technical specifications are not laid down in the Tender.

1.2 PLASTER OF PARIS

Plaster of Paris shall be of the calcium sulphate. Its fineness shall be such that when sieved through a sieve of I.S. Sieve designation 3.35 mm for 5 minutes after drying the residue left on it, shall not be more than 1% by weight. Initial setting time shall not be less than 13 minutes.

1.3 Preparation of Tiles.

The tiles of plaster of Paris reinforced with hessian cloth shall be prepared in suitable sizes as per drawing or as ordered by the Engineer in charge. The maximum size of tiles shall be limited to 75 cms. in each direction. Wooden forms of height equal to the thickness of the tiles shall be placed on a truly level and smooth surface such as glass sheet.

The section of form sides shall be such that the edges of the tiles shall be provided with a neatly formed chamfer alround of 5mm width and 8mm depth, unless the tiles are to be provided with cover fillets over joints, in which case the edges of the tiles shall be truly square. The glass sheet or the surface on which the form is kept and the form sides, shall be given a thin coat of non-staining oil to facilitate the easy removal of the tile. Plaster of Paris shall be evenly spread into the form upto about half the depth and hessian cloth weighing not less than 230 gms per square metre, shall be pressed over the Plaster of Paris layer. The ends of the hessian cloth shall be turned over at all edges to form a double layer to a width of 5 cms. The hessian cloth shall be of an open webbed texture so as to allow the plaster below and above to intermix with each other and form an integral whole. The form shall then be filled with

Plaster of Paris, which shall be uniformly pressed and then wire cut to an even and smooth surface. The tile so moulded shall be allowed to set initially for an hour or so and then removed from the form and allowed to dry and harden for about a week. A good tile, after drying and hardening, shall give a ringing sound when struck. The tiles shall be true and exact to shape and size and with clean and regular chamfers. The exposed face shall be truly plane and smooth.

1.4 Frame

G.I. frame of class and section as specified in the description of relevant item for the frame or as ordered by the Engineer in charge shall be provided. The width of the scantling provided shall be sufficient to provide a proper screwing surface. The longitudinal and header scantling shall be so arranged that the tiles can be fixed to form the panel arrangement required as per drawings, or as ordered by the Engineer in

charge and there is supporting scantling under each and every edge of the tiles. The framing shall be paid for separately unless specifically included in the description of the item.

1.5 Plaster of Paris shall be as specified in item 1.2 above.

1.6 Preparation of tiles Shall be as specified in item 1.3 above.

1.7 Fixing

The tiles so prepared shall be fixed to the cross battens of the ceiling frame with 40 mm brass screws at spacing not exceeding 20cm centre to centre on all edges. The tiles shall be laid with their edges in just close position to the adjoining tiles without any gap in between. The line of screws shall be not less than 15mm away from the edge of the tiles. The screws shall be slightly counter sunk into the tiles. Holes for screws shall be drilled. The counter sunk heads of screws shall be covered up with plaster of paris and smooth finished.

Where a surface unbroken by visible joints is required, then the joints shall be filled with plaster of paris and trowelled smooth so that the whole surface appears as one without any joints. Nothing extra shall be paid for this closing of joints.

1.8 G. I. PRESSED METAL SECTION FRAMEWORK FOR SUSPENDED CEILING.

The main load bearing member shall be C shape rectangular tube/ channel with two horizontal 28mm and one vertical 50mm sided and each ends of the C turned down 9mm, fabricated of 22 gauge (0.80mm) G.I. Sheet. The cross runner shall be furring channel with 50mm horizontal side, two vertical 10mm and two ends turned flat 15mm onwards, fabricated out of 24 gauge (0.63mm) G.I. sheet. Wall angle shall be 25mm x 25mm, 24 gauge (0.63mm).

The hangers or suspenders shall comprise 6mm dia. M.S bars, painted with a coat of steel primer of approved make. These will be fixed to 'L' cleats of M.S 25 mm x 25mm x 5mm and 75mm long fixed to the soffit of the of the roof slab with metallic expansion fasteners. The hanger rods of required length shall have threaded end with 2 M.S check nuts at the lower end fixed into holding clamp of size 75mm x 28mm and allowing level adjustment. The clamp will hold main runners which shall be running at not more than 1 metre centres in one direction. The cross runner with open side of the channel at top shall be placed below the main runner at right angles at distance as directed by the Engineer in charge but not exceeding 450mm centres in one direction. These will be anchored and screwed properly with main runners at every crossing with a 12 SWG, G.I. wire clip fixed diagonally around the main runner. The cross runners shall be fixed at centres not exceeding 300mm.

The wall angles shall be properly secured to walls with rawl plugs and screws and the ends of main and cross runners shall be supported on wall angle.

2.0 MINERAL FIBRE BOARD FALSE CEILING 2.1
Standards

DESCRIPTION	REFERENCE FOR CODES
In general	Shall be as per B.S. or equivalent Indian standards
Suspension system	Exposed semi recessed suspension system
Weight	Approximately 3.5 kg / sqm.

Light reflectance	Shall be greater than 83%
Humidity resistance	Shall be about 95% RH
Fire performance	
Reaction	Class 0 / Class 1 (BS 476)
Resistance	One hour fire rating
Acoustical criteria	
NRC (Noise reduction coefficient)	0.55
Sound Absorption	0.5
Sound Attentuation	0.32 decibels
Thermal conductivity	0.052 to 0.057 W/moK

2.2 Materials

2.2.1 Mineral Fibre boards

The mineral fibre boards shall be of shall be of approved make, design, shade and quality. The tiles shall be of specified size and thickness. The tiles have straight and square edges and shall be free from any breakages, marks, stains or bends.

2.2.2 Framework

The supporting framework shall comprise of sections of specified size and weight as per the requirements of the architect. The main runner shall be appropriately spaced and fixed to soffit by approved hangers. End hangers shall be at a suitable distance from the adjacent wall.

The cross tees shall be appropriately interlocked (both ways) between main runner to form a required module or grid. The wall angle shall be fixed to the wall at specified space intervals.

2.2.3 Workmanship

The ceiling shall be erected in a continuous sequence. All work in this section shall be performed in an efficient manner as per the instructions of the architect and as per manufacturer's recommended procedures. The assembly shall be of the semi-recessed type and shall be designed to meet the needs of performance, durability and aesthetics. The contractor shall make adequate provisions for adequate supports for lighting fittings, making cut-outs and extra framework for light fixtures, A.C. grills, speakers, trap doors, sprinklers, sensors, all detectors, etc., complete all as per lay-out / pattern as shown in drawing, as per manufacture's recommendations, as per approved shop drawings.

2.2.4 Protection

Prior to installation, the material shall be stored in a dry and clean area which is enclosed and protected from rain or other causes of excessive moisture and stabilised in the area for not less than 24 hours prior to installation.

2.3 Testing

The false ceiling system installed shall be tested for straightness and levels. The panels shall be true to shape and size as specified and shall be from any bends, scratches or visible marks, patches etc. The framework should be carefully examined for rigidity. If there is any sag, the panels should be dismantled and re-erected complete to the satisfaction of the engineer in charge. The maximum sag permissible shall be as per that defined in relevant B.S. or equivalent Indian standards.

2.4 Reference vendors / manufacturers Armstrong or approved equivalent

3.0 WATER RESISTANT FIBRE TILE FALSE CEILING

3.1 Standards

DESCRIPTION	REFERENCE FOR CODES
In general	Shall be as per B.S. or equivalent Indianstandards
Suspension system	Exposed semi recessed suspension system
Weight	Approximately 6 kg / sqm.
Light reflectance	shall be greater than 85%
Humidity resistance	shall be about 100% RH
Fire performance	
Reaction	Class 0 / Class 1 (BS 476)
Thermal conductivity	0.17 W/moK

3.2 Materials

3.2.1 Water resistant fibre tiles

The water resistant fibre tiles shall be of approved make, design, shade and quality. The tiles shall be of specified size and thickness. The tiles have straight and square edges and shall be free from any breakages, marks, stains or bends.

3.2.2 Framework

The supporting framework shall comprise of sections of specified size and weight as per the specific requirements. The main runner shall be appropriately spaced and fixed to soffit by approved hangers. End hangers shall be at a suitable distance from the adjacent wall. The cross tees shall be appropriately interlocked (both ways) between main runner to form a required module or grid. The wall angle shall be fixed to the wall at specified space intervals.

3.2.3 Workmanship

The ceiling shall be erected in a continuous sequence. All work in this section shall be performed in an efficient manner as per the instructions of the architect and as per manufacturer's recommended procedures. The assembly shall be of the semi-recessed type and shall be designed to meet the needs of performance, durability and aesthetics.. The contractor shall make adequate provisions for supports for lighting fittings, making cut-outs and extra framework for light fixtures, A.C. grills, speakers,

trap doors, sprinklers, sensors, all detectors, etc., complete all as per lay-out / pattern as shown in drawing and as per manufacture's recommendations.

3.2.4 Protection

Prior to installation, the material shall be stored in a dry and clean area which is enclosed and the material shall be allowed to stabilise in the area for not less than 24 hours prior to installation. Also care should be taken such that the material does not bear the weight of any unauthorised loads.

3.3 Testing

The false ceiling system installed shall be tested for straightness and levels. The panels shall be true to shape and size as specified and shall be from any bends, scratches or visible marks, patches etc. The framework should be carefully examined for rigidity. If there is any sag, the panels should be dismantled and re-erected complete to the satisfaction of the engineer in charge. The maximum sag permissible shall be as per that defined in relevant B.S. or equivalent Indian standards.

4.0 MEASUREMENTS

4.1 Measurements

Length and Breadth of superficial area of the finished work shall be measured correct to a cm. Area shall be calculated in square metre correct to two places of decimal. No deduction shall be made for openings of areas utp 40 dm2, nor shall extra payment be made either for any extra materials or labour involved in forming such openings. For opening exceeding 40 dm2 in area deduction in measurements shall be made, but extra will be payable for any extra material or labour involved in making such openings. Curved surfaces shall be measured and paid for separately from flat surfaces. The work shall be deemed to comprise of flat surfaces only unless specifically stated otherwise in the description of the item.

Any sunk or raised mouldings in the plaster shall be measured and paid for separately, deduction being made from plastering on ceiling only if the width exceeds 15 cm. Ceiling at a height greater than 5 metres shall be so described and measured separately stating the height.

4.2 Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including all scaffolding, staging, etc. The frame work supporting the ceiling will be paid for separately unless otherwise stipulated in the description of the item.

The rate does not include for any raised or sunk mouldings or for any patterned finishing of the surface, which will be measured and paid for extra over the plaster work.

WOOD WORK & JOINERY INCLUDING DOORS & WINDOWS

CONTENTS

1.0 SCOPE

The specifications refer to wood work in general including carpentry and joinery work in the building.

2.0 GENERAL

The provision of the latest revisions of the following I.S. codes shall form a part of these specifications.

IS 205 Specifications for non-ferrous metal butt hinges

IS 287 Recommendation for maximum permissible moisture content of timber used for different purposes.

IS 303 Specification for plywood for general purpose.

IS 362 Specification for parliamentary hinges

IS 419 Specification for putty for the use on window frames

IS 883 Code of practice for design of structural timber in building.

IS 1003 Specification for Timber panelled and glazed shutters Part II - Window and ventilator shutters.

IS1200 Method of measurement of building and Civil Part XXI Engineering Works - Wood Work and Joinery.

IS:1341 Specification for steel butt hinges

IS:1658 Specification for Fibre Hard Boards

IS: 1761 Specification for transparent sheet glass for glazing and framing purposes. IS: 3087 Specification for wood particle boards (medium density for structural timber in building)

Other I.S. codes not specifically mentioned here, but pertaining to wood work and joinery form part of these specifications.

3.0 MATERIALS

3.1 Sawn Timber

Teak wood / hardwood of good quality and class as specified in the item shall be used. The timber shall be of high quality and well seasoned. It shall have uniform colour free from defects such as cracks, dead knots, shakes, sapwood etc. No individual hard and wound knot shall be more than 6 Sq.cm in size and the aggregate area of such knots shall not be more than 1% of the area of the piece. The timber shall be close grained having not less than 2 growth rings per cm. width in cross section. The maximum permissible percentage of moisture content for well seasoned timber used in building work shall be as specified in the IS : 287.

3.2 Glazing materials

3.3 Glass Panels:

Unless otherwise specified, glass panes used in glazed or panelled and glazed shutters, shall be of good quality glass of thickness not less than 2 mm for panes upto 0.1 sq.m in area not less than 3 mm for glass panes of area larger than 0.1 sq.m with a tolerance of

0.2 mm in both cases.

The glass shall be free from flaws such as specks, bubbles, smoke waves, air holes, etc. and shall conform to the relevant IS : 1761. Unless otherwise specified, glass panes used in shutters of bath room and lavatories shall be frosted and of thickness as mentioned above and shall be free from any flaws.

Where so specified, special quality glass such as plate glass, pin heads glass, wired glass, float glass etc. shall be used. They shall conform to relevant IS standards as regards quality. Putty for glazing in wooden frames of doors and windows Putty shall be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil and mixing the whole thing into a homogeneous stiff paste. It shall be free from impurities like dust, grit, etc. and shall conform to IS : 419.

3.4 Fittings

The item of wood work of joinery generally includes fittings such as hinges and screws for fixing of door shutters and is explicitly so mentioned in the item. Hinges - Hinges shall be of iron, brass, aluminium or any other material as specified. They shall present a neat appearance and shall operate smoothly. All hinges shall be of steel and their riveted heads shall be well formed and smooth. Hinges shall be of the type specified and shall conform to the relevant Indian Standard Specifications.

4.0 WORKMANSHIP

4.1 Wood Work, Wrought, Framed and Fixed

General:

The work shall be carried out as per detailed drawings and/or as directed by the Engineer incharge. The wooden members of the frame shall be planed smooth and accurate to the full dimensions. Rebates, rounding, mouldings, etc. as shown in the drawing shall be done before the members are joined into frames. Where wood work is not exposed to view as in the case of frames for false ceiling, however, no planing is required to be done unless specified expressly as rough timber work.

Note: The work wrought shall mean 'planed'.

Jointing in timber frames must be made carefully and accurately. They shall be strong, neat and shall fit without edging or filling. The joints shall be pinned with hard wood or bamboo pins of 10 to 15 - dia after the members of the frame are pressed together in a suitable vice-mechanism The door and window frame shall have rebate to house the shutters and the depth of such rebate shall be 1.25 cm.

Wood work shall be painted, oiled, polished or otherwise treated as specified. All portions of timber abutting against masonry or concrete portion of building shall be coated with boiling coal tar or other type of approved wood preservatives primer, before

placing them in final position. Before any surface treatment is applied in the wood work shall be got approved by the Engineer-in-Charge.

Fixing in Position:

The frames shall be fixed only after acceptance by the Engineer-in-Charge. In case of door frames without sills, the vertical members shall be buried in floor for the full thickness of the floor and the door frame shall be temporarily braced at the sill level so as to prevent warping or distortion of frame during construction.

4.2 Panelled, Glazed or Panelled and Glazed Shutters:

General

The work shall be carried out as per detailed drawing. The wooden members shall be planed smooth and accurate. They shall be cut to the exact shape and sizes without patching or plugging of any kind. Mouldings, rebates, rounding, etc. shall be done, as shown in the drawing, before the pieces are assembled into the shutter.

Joinery work:

The thickness of the styles and rails shall be as specified in the item of work. The minimum thickness of panels shall normally be 15 mm where the clear width of panel is not more than 300 mm and 20 mm where the clear width of the panel is more than 300

mm. However, where the Engineer-in-Charge so considers lesser thickness upto 12 mm and 15 mm respectively may be allowed by him instead of 15 mm and 20 mm specified above. Solid wood panel for door and window shutters shall be made out of one or more strips of timber planks of not less than 125 mm width. it is preferable to use strips of not more than 200 mm width to reduce chances of warping, splitting or other defects. The timber strips shall be joined together with continuous tongued and grooved joints, glued together and reinforced with metal dowels. The grooving of the solid panel shall normally run along the longer dimensions of the panel unless otherwise directed. The corners and edges of panels shall be finished as shown in the drawing and these shall be feather tongued into styles and rails. Sash bars shall have mitres joints with the styles. Styles and rails of shutters shall be made out of single piece. Lock and intermediate rails exceeding 200 mm in width if permitted by the Engineer-in-charge may be made out of one or more pieces of timber but the width of each pieces shall not be less than 125 mm. Where more than one piece of timber is used, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels (rust proof) at regular intervals of 20 cm or pinned with not less than three 40 mm rust proof pins of the lost head type.

The tenons shall pass clear through styles. The styles and rails shall have a 12 mm groove to receive the panel. In case the double shutters the rebate at the closing junction of the two shutters shall be of depth not less than 2 cm.

Shutters shall not be painted or otherwise treated before these are passed by the Engineer- in- Charge and fixed in position.

4.3 Glazing:

The glazing work shall be done in accordance with the specification given separately elsewhere.

4.4 Hold Fasts

Hold fasts used for fixing doors and window frames shall be made of 40 x 3 mm flat iron and 40 cm long. It shall have two holes on one end for fixing to frame with long screws, and at the other end, the flat iron shall be split and bent at right angles in the opposite direction. The hold fast shall be tightly fixed to the frame by means of bolts, the bolt hole in frame being plugged suitably and finished neat. The hold fast shall be embedded into masonry by concrete block of 200 x 250 x 400 mm size.

5.0 MEASUREMENTS

Woodwork and joinery work shall be measured in square meters. Length and width of unfinished opening shall be measured to the nearest 0.01 m. Areas shall be worked out correct upto 3rd place of decimal of a sq.m. All work shall be measured net as fixed, that is, no extra allowance in measurement shall be made for shape, joints, etc. However, where the dimensions as fixed exceeds the specified dimension (as per drawing, etc.) only the specified dimensions(s) shall be measured and where one or more dimension of the piece as fixed is less than the fixed dimension the actual dimension shall be measured, without prejudice to the right of the Engineer-in-Charge to reject the piece and order replacement of such pieces.

It shall include:

i) Supply of specified species of timber sawn to requisite sizes without any defect, wrought, framed and fixed in position with the required standard of workmanship including supply-and-fixing of fixtures, straps, bolts, hold-fasts, spikes, nails, screws, etc. applying contractors glue or other jointing materials, coal tarring embedded parts, glazing and supplying and fixing of all specified fittings.

ii) All material, labour, scaffolding, use of equipment etc. for framing, fixing and completing the item as specified.

6.0 FLUSH DOOR SHUTTERS

6.1 General

The door shall be of flush type solid core with single or double shutter as the case may be.

6.2 Shutters

The shutters shall be decorative or non-decorative type of the exterior or interior grade as described in the item and as shown in the drawings. It shall conform to the relevant specifications for the type and grade given in I.S. 2202/1983, Specifications for Wooden Flush door shutters (solid core type). The finished thickness shall be as mentioned in the item. Face veneers used shall be of the pattern and colour approved by the Engineer.

6.3 Fixtures and Fastenings

These shall be as shown in a table on the drawings or as indicated in the specifications. Where it is not specified they shall be of oxidised brass and shall be of good workmanship. All fixtures and fastenings shall be sound and strong. They shall be sectional and of the best quality. The size, shape, design and finish shall be as shown on drawings and approved by the Engineer.

Unless otherwise specified each leaf shall be hung with three brass parliamentary hinges to suit the locations for back flap with brass screws. Each door shall be furnished with aldrop and latch, brass flush bolts, etc. The fixtures shall comply with the relevant Indian Standards. Samples of all fixtures and fastening shall be got approved by the Engineer and deposited in his office for reference.

All the fixtures shall be fixed to the joinery in a secure and efficient manner. Metal sockets shall be provided to all bolts where the shoots enter, stone, concrete, etc.

6.4 Measurement

Flush door shutters shall be measured in square metres. Length and width of unfinished opening shall be measured to the nearest 0.01 m. For further details of measurement of flush door shutters see clause 5.0

STRUCTURAL GLAZING & CLADDING SYSTEMS

STRUCTURAL GLAZING & CLADDING SYSTEMS

CONTENTS

1. SCOPE OF WORKS

The scope of works under this contract includes design, supply, installation, protection, guarantees, testing and maintenance upto the defects liability period for Structural Glazing, Curtain Wall, Aluminium Cladding, Stainless Steel Sheet Cladding, Sun shading device / Sun-breaker assembly, Doors, Sky-light, Windows, Louvres etc.

The work under this section includes all Labour, materials, equipment and services as required for the complete design, engineering, testing, fabrication, assembly, delivery, anchorage, installation, protection and waterproofing of the aluminium curtain wall / structural glazing system, cladding, aluminium doors, Sky-light, aluminium windows & louvres and all in accordance with the true intent and meaning of the specifications and drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings or described in the specification provided that the same can be reasonably inferred there from. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required to secure aluminium structural glazing system, cladding, Sky-light and louvers to the building structure.

The detailed scope of works consists of :-

1. The aluminium structural glazing system, cladding, Sky-light, Sun shading device / Sun-breaker assembly, aluminium doors, aluminium windows & louvres described hereafter shall include but will not necessarily be limited to the following:- a. Frames, vision panels, spandrels, doors and ventilators.

b. Openable panels where indicated, inclusive of all accessories, fittings etc.

c. Copings, soffit trimmers, and external metal cladding panels for both the wall cladding and the curtain walling system.

d. Aluminium doors, aluminium windows, aluminium fix glazing, louvres etc. wherever indicated.

e. All caulking, sealing and flashing including sealing at junctions with roof waterproofing and exterior wall, flashing at doorway, raised kerbs and in window surrounds.

f. Sealant within and around the perimeter of all work under this section.

g. Separators, neoprene / EPDM / silicon gaskets, trims etc.

h. All steel structural framing and beam supports, anchors and attachments as required for the complete installation of the whole system, wherever specified.

i. Inserts in concrete, anchor fasteners etc. for the anchorage of all work under this section to the approval of Architect.

j. Isolation of all dissimilar metal surfaces as well as moving surfaces similar or dissimilar.

k. Fire-stops, Flashings, Sealing of all interfaces with buildings etc.

l. Protection during storage and construction until handing over.

m. Engineering proposals, drawings and data.

n. Shop drawings, engineering data and structural calculations of all systems including framing, fasteners and cladding.

o. Scheduling and monitoring of the work.

p. All samples, mock-ups and test units.

q. Co-ordination with work of Civil Works and other agencies / contractors employed on site.
r. All final exterior and interior cleaning of the aluminium structural glazing system, cladding, doors louvres and window etc.
s. Hoisting, staging, scaffolding and temporary services.
t. Specified tests, inclusive of necessary reports.
u. Maintenance manuals.
v. Design and Performance guarantees.
w. Periodic inspection, supervision and advice by Contractor's Senior Personnel of the System Principal as well as guarantee in approved Proforma for the quality and performance of works.
x. Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the shop drawing details (including any modification made during testing) and acceptable standards of quality.

2. REFERENCES AND STANDARDS

2.1 The provisions not restricted to the latest Standards listed below and mentioned in subsequent Para's.

ANSI	Z97.1.84	Safety Glazing materials used in Buildings
ASTM	C 1036-90	Specification for float glass
ASTM	C 1048-90	Specification for Heat treated Float Glass
ASTM	E 774 –88	Specification for sealed Insulating Glass Units
ASTM	C 1172- 91	Specification for Laminated Architectural Glass
ASTM	C 864 – 90	Specification for compression Seal Gaskets
ASTM	C 1115-89	Specification for Silicon Rubber Gaskets
ASTM	C 920-87	Specification for Sealants
ASTM	C 509-90	Specification for sealing material
CPSC	16 CFR 1201	Specification for Safety of glass
GTA Specification 89-1-6		Specification for environment durability for heat NO strengthened Spandrel Glass with Applied pacifiers.
BSCP	118	Structural use of Aluminium
ASTM	E 283	Air Infiltration test
ASTM	E 331	Static water penetration
test ASTM	E330	Positive and negative Test
AAMA		501.1 Dynamic Water Penetration Test-600Pa equivalent wind speed by propeller engine.
AAMA	501.4	At 100% 0f the specified lateral displacement.
AS N25	4284	Seismic test
IS 875	1987 Part 3	Code of practice for design Loads (other than Earthquake) Wind Load

In general the Contractor may follow any International Standards subject to his satisfying the Architect/ Employer that these specifications are equivalent to latest specifications issued by ASTM, ISO, AAMA, BSS & SSIR.

Copies of all standards & codes proposed to be followed for design, materials, installation and testing shall be submitted to the Architect within 2 weeks of issue of Works Order.

2.2 Building Regulations

Design of the aluminium structural glazing system shall comply with all Government codes and regulations. For wind design, all calculations shall comply with the requirements of the relevant National Building Code and Indian Standard Code, unless specified otherwise.

3.0 GUARANTEE

The Contractor shall be fully responsible for and shall guarantee proper design and performance of his installed system for a period of 10 years from handing over of works. The design and installation shall be to the best international standards and shall specially take account of wind and seismic loads, storms, air pollution, thermal stresses, building movements and the like

In addition specific 10 year guarantees (to be furnished in non-judicial stamp paper of value Rs.100/-) in approved Proforma shall be given for performance of glass, glazed units, anodizing, PVDF coating to cladding sheets and sealants. All the Guarantees shall be submitted before Final payment and shall not in any way limit any other rights to correction which the Employer may have under the Contract.

4.0 CONTRACTOR'S RESPONSIBILITIES

4.1 The Contractor's responsibilities include but are not necessarily limited to the following items:

a) The Contractor shall provide and install all supplementary parts necessary to complete all items generally implied in the drawings and in the specifications though not specifically shown or mentioned. This shall include the design and sizing of all sections and anchor assemblies to meet the performance and design requirements, furnishing and installation of all inserts, fasteners, clips, bracing and framework as required for the proper anchorage of the structural glazing system elements to the structure, unless otherwise noted or specified to be furnished / installed by another contractor. Alternate anchorage proposals will be considered, if, in the opinion of the Architect the general design and intent of the drawings and specifications are maintained. The Contractor's system therefore must perform satisfactorily as a whole. b) Design Responsibility: Drawings and specifications indicate the required basic dimensions, profiles and performance criteria. The Contractor shall have the option of modification and addition of details provided the visual concept and performance requirements are fulfilled. Proposed modifications shall be clearly shown on shop drawings as "Design Modifications" and acceptance of the same will not relieve the Contractor from sole responsibility for performance of the aluminium structural glazing system and cladding. The Contractor shall be solely and fully responsible for due performance of his installation based on his own design and details.

c) In-plant and job site inspection: The Contractor shall allow the Employer, Architect / PMC or their authorised agent full access to plants, shops and assembly points to view and inspect the processes and methods employed in the fabrication, assembly and finishing of the aluminium structural glazing system and cladding for this project. The Architect / PMC will have the right to reject any and all aluminium structural curtain wall / structural glazing system and cladding components and assemblies during assembly and erection if the workmanship and intent are not in strict conformity with the approved shop drawings, structural calculations, documentation, certifications, samples and mock-up.

d) Glass, sealants and other items or materials procured by purchase shall be back to back guaranteed by the manufacturer.

5.0 SHOP DRAWINGS

5.1 The contractor shall prepare necessary shop drawings based on the preliminary drawings and two (2) copies of all shop drawings shall be submitted to the Architect for review and approval. The Architect's review of all shop drawings will be limited to their conformity to the design concept & specifications. Architect's approval of the shop drawings will not relieve the contractor from any of the responsibilities and requirements as stated drawings and all other related submissions, documentation, certifications, samples and the mock-up for that work have been reviewed and approved by the Architect. On approval of the drawings by Architect, the Contractor shall submit six (6)copies of all drawings to PMC for release to execution / site.

5.2 Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and full size details for all work in this section.

Shop drawings shall indicate the desired dimensional profiles and modules, function, design and performance standards and, in general, delineate the scope of work. The contractor shall verify and co-ordinate these items with all applicable and/or related trades, contract drawings and specifications. Since the dimensions and modular references shown on the drawings are for specific and/or typical detail, the shop drawings shall include a full complete layout of all modular and referenced dimensions for all the aluminium structural glazing, cladding, doors, windows and louvres and their related elements. All dimensions / modules, etc., shall be field checked as required.

The full size details shall show and specify all metal sections, types of finishes; areas to be sealed and sealant materials; gaskets; direction and magnitude of thermal expansion; direction and magnitude of all applicable construction including fasteners and welds; all anchorage assemblies and components; the fabrication and erection tolerances for the work and applicable related works adjoining, attached to or in some way related to the work covered by these specifications. The location of all static and dynamic anchor assemblies, the direction of thermal and other applicable building movements, coordination with concrete works and the sequence of installation shall be designated on the applicable plans, elevations and / or sections. All details shall be subject to Architect's approval.

5.3 Shop drawings shall indicate the desired profiles, dimensions, details of metal finish and in general delineate the scope of the work. Profile adjustments in the interest of economy, fabrication, erection, weather-ability or ability to satisfy the performance requirements may be made only with the written approval of the Architect, provided that the general design and intent of the drawings and specifications are maintained.

5.4 Shop drawings to be vetted by the Principal of the Structural Glazing & Cladding System. Six (6) copies each of all final approved shop drawings shall be submitted to Architect / PMC.

6.0 STRUCTURAL CALCULATIONS

6.1 The Contractor shall guarantee that his design will ensure the structural safety and integrity of the curtain wall, cladding and glass panels against all natural forces, superimposed loads, environment and consequent movements. For that purpose the contractor shall employ a competent design engineer to design his systems and components. During the design stage, the Contractor shall interact actively with the Architect concerning all aspects of design and shall obtain all the information from them concerning the structure, probable deflections and other building movements etc. The Contractor shall take full account of all possible building movements as well as the movements of his curtain wall and cladding systems in his design. The Contractor shall submit his detailed structural calculations for the systems and each of their components and shall guarantee that his design will ensure the structural safety and integrity of the curtain wall, cladding and glass panels against all natural forces, superimposed loads, and environment and consequent movements.

The structure and functional design must be vetted and approved by the Principals of the curtain wall system.. The Contractor shall obtain the Architect's approval to his design calculations and to the provisions made in his design for all the building movements, and shall be responsible for the correctness of the fixing and interaction of the curtain wall with the structure so as to ensure that all the movements envisaged between the structure and the curtain wall area are fully taken care of. The Contractor shall be responsible for the workmanship of fabrication and installation and shall indemnify the Employer against all claims due to defects or non-performance during the specified 10 year Guarantee period.

The provisions of this clause shall not in any way limit the Employer’s rights under other clauses of the Contract.

6.2 The R.C.C. in the building structure is Grade M 30. The Contractor shall design anchorages for this grade of concrete with adequate safety factor.

6.3 Three (3) sets of approved design calculations which is compatible with R.C.C. and steel structure shall be submitted to Architect.

7.0 DOCUMENTATION AND CERTIFICATION

7.1 Glass and Glazing Documentation:

The applicable glass manufacturer(s) shall submit written certification for Architect’s review and approval stating that all glass and glazing requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their

specific application and / or design parameters, compatibility to adjacent materials and in conformity with all requirements as detailed and specified in the Contract Documents. Certification shall further state that the proposed glass and glazing materials are most appropriately suited for the use or uses intended and recommended for the specific use or the selection of the glass and the glazing materials including, but not limited to, gaskets, setting blocks, sealant, the design and dimensional parameters of the glass pockets and the compatibility of materials. Test Certificate from approved laboratories for U-values and shading factor claimed by the Manufacturer shall be submitted.

7.2 Sealants Documents:

All sealant applications must be clearly designated on the applicable shop drawing details and referenced to a master sealant schedule specifying materials, special instructions and application procedures. The applicable sealant manufacturer(s) shall submit in writing that all sealant requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and / or design intent, compatibility to adjacent materials and in conformity with all the requirements as detailed and specified in the contract documents. The manufacturer's certification shall specify the optimum life expectancy, in years, for the proposed sealant materials as detailed and specified on the shop drawings and/or master sealant schedule and shall further state that the proposed materials are most appropriately suited for the use or uses intended and recommended for the specific use or uses.

7.3 Quality Control Documentation:

7.4

In-plant and job site quality control procedures shall be documented in writing for Architect's review and approval to ensure the design integrity and performance of the as built product. Documentation shall include schedule, details, isometric and/or schematic explanatory sketches cross-references to the shop drawings, data sheets, etc., all as required to intelligently witness and assess methods and materials; and to ensure that both the fabrication and installation are in accord with the contract documents.

The Employer / Architect / PMC shall, if required, be given free access to the plant to inspect fabrication procedures. No fabrication or assembly of job site materials shall commence until the first production unit is inspected and approved by Architect / PMC.

a) The in-plant quality control procedures shall include but not necessarily be limited to the following items:

Fabrication	: Tolerances, Joinery, Sleeves, etc.
Finish Match	: Approved finish controls required for matching the exposed surfaces.
Assembly	: Welds, fastener, sealants, gaskets, separators, glazing etc.
Protection	: Handling, protection, shipping etc.

b) The job site quality control procedures shall include, but not necessarily be limited to the following items:

Anchorage	: Lines, grades and related building tolerances
Installation	: Tolerances, finish, match, joinery, sleeves, flashing, welds, fasteners, sealants, etc.
Sealing	: As recommended by the applicable sealant manufacturer(s)
Protection & Cleaning	: As recommended by the applicable sealant manufacturer(s)

8.0 SAMPLES AND MANUALS:

8.1 The following samples of actual job site materials together with detailed technical data / catalogues shall be submitted in duplicate, unless otherwise noted, and in the sizes noted, for Architect's review and approval. Any omission of an item, or items which require the Contractor's compliance with these documents does not relieve him from such responsibility.

(a) Aluminium sheet panel: Each type and thickness; 600 x 600 mm of the specified thickness.

(b) Aluminium extrusions; one only of each section ; 300 mm long of specified thickness.

(c) Glass; Each type and kind, 300 x 250 mm of specified thickness and including frame.

(d) Glazing gaskets, tapes, separators, glass setting blocks, etc. each section or unit, 300 mm long or unit.

(e) Fasteners and connections devices: Each type and size.

(f) Finish samples: After approval of the final finish coating the Architect / PMC is to be provided with six (6) approved samples.

(g) Window and door ironmongery and accessories, as applicable.

(h) Flashings and finish samples.

(i) Cladding.

(j) Samples submitted should be also include assembly of various components forming a typical fixing and details complete with flat sheets, glazing, extrusion, fastener, sealants etc.

8.2 Mock - Up

Before the fabrication and site installation is taken up, the Contractor shall put up a mockup of his proposed curtain wall / structural glazing system & aluminium cladding system at least 4.00 m high and 3 modules wide incorporating all types of in-fill panels, fire-stop, flashing, shadowbox, bracket, hardware and fixtures. A mock-up of 4 panels of cladding shall also be put up. The mock-up are essential for final approval of all materials and installation details by the Architect.

The Contractor shall submit samples and catalogues of door / window elements for approval, as applicable.

8.3 Maintenance Manual:

Submit Maintenance Manuals approved by Architect / PMC in three (3) copies each indicating the detailed procedures for the periodical inspection maintenance and cleaning of all the structural glazing, cladding, doors, windows and louver elements, finishes etc.

9.0 WORK SCHEDULE:

9.1 Immediately on receipt of the Work Order the Contractor shall submit the final programme of work schedule for the completion of the whole of the works including submittals, approvals, fabrication, supply at site & installation. The time schedule shall be got approved from the PMC.

9.2 The time schedule shall be prepared in consultation with PMC to suit the overall project schedule and shall be updated from time to time to suit prevailing conditions and coordination with other Contractors employed on site.

10.0 INSPECTION OF COMPONENTS:

10.1 The Contractor shall submit a schedule of material specification and procedure for inspection of the quality of components of the metal wall cladding / curtain walling the fabrication in the plant.

10.2 The Contractor shall submit fortnightly report on the results of the inspection of the components, in a format approved by the PMC.

10.3 The Contractor shall submit a description of the procedure of delivery, hoisting, storage, handling, fixing, scaffolding, temporary working stage or gondola, protection and cleaning.

11.0 STORAGE, PROTECTION AND PROGRAMME

11.1. The Contractor shall submit a schedule on the procedure for inspection during installation so as to maintain quality control on the job site.

11.2. The Contractor shall submit a detailed method statement for the protection of the surface of the aluminium structural glazing & cladding members during delivery and erection, with description as to when the protection can be removed.

11.3. The Contractor shall submit weekly reports on the inspection of erection and installation as direction by the PMC.

11.4. Delivery and Storage and Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials will not be exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.

a) Aluminium wall cladding / Factory made structural glazing units and / or their components shall be transported, handled and stored in a manner to preclude damage of any nature.

b) Accessory materials, required for erection at the site shall be delivered to the site in labeled containers by the manufacturer.

c) Remove all units or components which are cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace them promptly.

12.0 PERFORMANCE REQUIREMENTS

All components, assemblies and completed work included in or permit to the work of this section shall conform to or exceed the following performance standards and comply with all applicable and governing building codes and regulations.

12.1. Thermal Movement: Provide for noiseless contraction and expansion of component materials for an ambient temperature range of +10°C to 70°C and a material temperature range of 100°C without buckling, opening joints, glass breakage, undue stress on fasteners, or other detrimental effects. Make allowance for vertical and horizontal expansion. For fabrication, assembly and erection, procedures shall take into account the ambient temperature range at the time of respective operations.

12.2. Building Movement and Related Building tolerance. The design and installation of the structural glazing system shall accommodate all inherent building movements and/ or deflections and the fabrication and installation tolerances of all related work not involved in this section without the loss of, or any detrimental effect to, the performance requirements herein specified. The Contractor shall verify and co-ordinate all such movements and / or tolerances with the Architect and the Architect before designing all the components of structural glazing and aluminium cladding so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain wall and aluminium cladding and vice versa.

12.3. Thermal property:

All insulation materials, fire-stops and smoke seals shall comply with the current requirements of the Local Chief Fire Officer, Fire Brigade and other authorities.

12.4. Structural Properties:

a) The design of curtain wall / structural glazing system and aluminium cladding and all related components shall comply with the requirements of National Building Code I.S.875 and Indian Standard Code I.S.456.

b) No curtain wall / structural glazing system and aluminium cladding elements including sealants and sealed joints shall sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure herein specified.

c) Deflections: The specified deflections must be reduced if they are in any way detrimental to the aluminium structural glazing and cladding elements and sealants. (Refer to clause 27.0 on page TS- Structural Clad-56.)

12.5. General

1) All braces, supports and connections for the aluminium curtain wall / structural glazing and cladding shall be designed, provided and installed complete as required.

2) Anchors for curtain wall shall be located within a maximum distance of 500 mm above or below the R.C.C. floor slab unless specifically approved otherwise by the Architect.

3) Variations from schematic layouts indicated on the drawings may be permitted but only if a proposed revision does not, in the Architect's opinion, deviate from the design intent, cause excessive stress in the structure, cause excessive deflection, inhibit thermal and building movement or conflict with other requirements.

4) Member shapes and / or profiles if schematically shown on the Architect's drawings are not necessarily the exact shapes required or best suited for the particular condition. Final shapes and locations shall be as designed by the contractor and are subject to the Architect's review and approval.

5) The height-from the finished floor level to the top of the window sill shall not be less than as shown in the drawing.

The horizontal or lateral load on such transom / railing (where not backed by an R.C.C. parapet) shall be designed in accordance with the following criteria i.e. a horizontal UDL at 0.74 KN/m run, UDL supplied to the infill of 1.0 KN/m2 and a point load applied to part of the infill at 0.5 KN.

6) No holes shall be burned, filed or drilled in any structural steel members unless approved by the Architect in writing.

7) The contractor shall provide detailed layouts, alignment jigs etc. for the proper and exact placement of all welded anchor studs, anchorage components, embedded anchor assemblies etc.

8) All metal structural glazing and cladding elements and their applicable anchorage assemblies shall be designed to accommodate all thermal and building movements without any harmful effect to the structural glazing and cladding.

9) No field forming, cutting and/or alterations of primary wall elements will be allowed. All framing members shall be shop fabricated and finish coated. No unfinished surfaces will be permitted on exposed surfaces.

12.6. Concrete Tolerances:

a) The contractor shall take into account tolerance in concrete and masonary surfaces to which the structural and glazing framework is fixed.

b) In general, the construction tolerances in the building shall be as follows.

- Surface level of floor slab, sills and lintels ±10 mm
- Plumb in a storey height ±10 mm
- Plumb in full height of building ±14 mm
- Cross – diagonal distortion between columns ±14 mm
- Max. displacement of any point on External Fascia from its true location ±14 mm

12.7. Lightning protection

The whole of the curtain wall when having insufficient clearance from the lightning protection system shall be bonded as directly as possible to the lightning protection system. At each end of each continuous length of curtain wall, cladding or louvres, provision shall be made at top and bottom for bonding by the electrical contractor engaged by the Employer. The exact locations and details of the bonding points shall be as determined by the Architect.

12.8. Fire-stop and Interface with building.

Joints in the curtain wall / structural glazing system between successive floors shall have the required fire resistance of at least 2 hours and shall comply with requirements of

C.F.O. A fire-stop-cum-smoke seal shall be provided at each window-head level. In addition the Contractor shall provide an aluminium flashing to approved design at the window sill level and on 2 sides of vision panels.

All interfaces with building structure, and other elements shall be sealed / flashed / provided with expandable gaskets to Architect's approval.

12.9. Sound Control

Provisions shall be made (e.g. capping of all ends of mullions) to prevent sound transmission through the system. Provisions shall also be made to prevent metal to metal rubbing noise due to thermal changes and wind pressure. Desired sound levels should be 35 - 45 dB and shall not be more than 45 Db

MATERIALS

13.0 GENERAL:

13.1. Materials and components used shall be of the best quality and suitable for the purpose to Architect's approval and shall have been tried and tested in similar environments.

13.2. Aluminium panels shall be of a minimum thickness of 2 mm and of max. 3 mm (except Para 14.5) for solid sheets, and 4 mm for insulated composite units.

13.3. All materials shall be free from any defect that may impair the strength, functioning or appearance of the glazing and cladding system or adjacent construction.

13.4. Testing by independent testing laboratories or review of data by the Architect shall not relieve the Contractor's responsibility to verify for himself that the work conforms to the intent of the contract documents.

14.0 METALS

14.1. In general, metals shall comply with relevant Indian and International Standards.

14.2. Aluminium Wall Cladding

The aluminium cladding shall be fabricated with a minimum of 4 mm thick aluminium composite panel of approved make comprising of a thermoplastic resin core sandwiched between two skins of aluminium alloy. The panels shall be PVDF coated to minimum 35 micron thickness in approved metallic colour. The resin content of the PVDF shall be minimum 75%. The back of the panel shall be chromatised minimum 3 micron thick or otherwise protected to Architect's approval. The insulation in-fill of the composite panel shall be non-toxic on burning. The panels shall be acceptable to the Chief Fire Officer.

14.3. Fasteners: The type, size, alloy, quantity and spacing of all fasteners and / or anchorage devices shall be as required for the specified performance standards.

a) Bolts, anchors and other fastening devices shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise noted, shall be suitable for the conditions encountered, and shall be torque tightened, where required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners.

b) Fastening devices between aluminium and aluminium shall be Grade 304 of AISI non-magnetic stainless steel unless otherwise approved.
c) Fastening devices between aluminium and dissimilar materials shall be Grade 304 of AISI non-magnetic stainless steel unless otherwise approved.
d) Exposed fasteners are subject to Architect's approval and shall be M.S. epoxy coated.
e) Self-locking fasteners shall be stainless steel of grade 304 with nylon inserts or patches.

14.4. Extrusions:

All aluminium extrusions shall conform to the system principal's specification for tolerances which shall, in any case, be better than DIN standards. Any section not conforming to the tolerances shall be rejected. In general aluminium alloy for extrusions shall be 6063 T5 or T6 as per B.S.1474. However, the grade and tempering specifications shall be as recommended by the supplier for each application and shall be approved by the system principal. All aluminium sections shall be either anodised in approved colour to a minimum thickness of 35 microns or coated with PVDF as specified in clause19.0 except for sections concealed from view behind cladding which may be mill-finished. All surfaces abutting the parent sections and designed to receive sealants shall have adequate sealant contact and adhesion. They shall be finished to match parent sections.

14.5. Aluminium Flashing

Flashings concealed from view shall be made from mill-finished aluminium sheets 1.5 mm thick. Visible flashings (e.g. on periphery of vision panels) shall be 2 mm thick aluminium sheets anodised in approved colour.

14.6. Capping

Top capping shall be from 3 mm stretch-levelled aluminium sheets coated with 35 micron PVDF in approved colour.

14.7. Soffits and Suspended Ceiling System

Soffits and suspended ceiling system if required shall be of similar metal of the aluminium wall cladding with a similar finish. Colour and shape shall be selected by the Architect.

14.8. Fire stops – cum – smoke seals.

Fire stops – cum – smoke seals shall be provided at successive floor levels, and shall be two hour fire resistant. Metals sections shall be in galvanised steel sections minimum 1.5 mm thick. All details shall be approved by the Architect.

14.9. Protection:

Materials used as permanent or temporary protection for metals shall conform with relevant Indian / International Standards.

14.10 Brackets:

Brackets shall be of chromotised Aluminum of grade 6161-T6 or 6005-T6 conforming to ASTM 6511/A and approved by Architect. Slots in brackets shall be pre-drilled / punched and not flame-cut.

14.11 Hardware and Fittings:

All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs etc. for doors windows and openable panels shall be stainless steel to best International

standards and to Architect's approval. Hinges for openable panel shall be stainless steel friction hinges / stays selected for specified wind load and dead loads or specifically extruded in-built hinges. All fittings and locks shall be approved by the Architect.

15.0 SEALANTS & GASKETS

15.1 All sealant applications must be clearly designated on the applicable shop drawings details and reference to a master sealant schedule specifying materials, special instructions and application procedures. Provide documentation as per Clause 7.2.

15.2 The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required cure and optimum performance. Sealants must not degrade and / or fail under all design conditions including, but not limited to thermal movement, water, ultraviolet exposure and / or other adverse environmental conditions. The following sealant materials are specified for performance standards only.

All proposals must be equal to or better than the materials herein specified. The designation of sealant types noted on the drawings is intended for general design guidance. Final selection by the contractor for the sealant types shall be based on their conformity with the Performance Requirements herein specified and meets with the Architect's approval. Maximum precautions shall be taken to prevent failure of sealant.

15.3 Structural sealant: Structural sealant shall be Dow Corning Silicone sealant 995, GE ultraglaze 4000, or approved equivalent recommended by manufacturer. All exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly), perimeter metal to concrete joints shall be silicone base sealant, preferably 2 component, in approved colour, conforming to the manufacturer's recommendations for the specific uses and performance criteria. The manufacturer shall conduct laboratory test for adhesion for each lot of aluminium sections and glass. Laboratory reports shall be submitted to the Architect.

15.4 Weather Sealant: The grades of sealants for concealed metal to metal and metal to concrete joints such as embedment and lapping of flashings elements to be installed or embedded in a full bed sealant shall be the best recommended by the manufacturer for the application. (Dow Corning, GE or equivalent).

15.5 Joint fillers and back-up materials shall be non-gaseous polyethylene foam, sponge neoprene as per written recommendations from the applicable sealant manufactures for each specific application. Shape, size, hardness, compatibility and bond breaking requirements are all factors to be considered.

15.6 All sealant must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and / or applied colour coatings.

15.7 Exposed assembly sealant will not be permitted at any wall area.

15.8 All sealants shall be given 10 years Guarantee for materials, workmanship and performance from the date of completion of Contract.

15.9 Caulking compound: Dow Corning 991 or approved equivalent, one part gun grade consistency, colour to match adjacent material or approved by Architect for use around frame or between frame and floor slab.

15.10 GASKETS:

A) SILICON GASKET: All Gaskets and seals shall be SILICON of approved quality, compatible with substrates, finishes and other components they are in contact with.

16.0 SEPARATORS

16.1 Separators between steel and aluminium members and wherever required shall be rigid type, high impact, smooth both side Teflon with a minimum thickness of 0.8 mm or other non-conducting materials as approved by the Architect.

17.0 GLASS

17.1 All glass and glazing materials shall be verified and co-ordinated with the applicable performance requirements.

17.2 Finish and install glass and glazing work as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and ready for glazing. Any pane which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor's expense. All glass shall be of accurate sizes with clear undamaged edges and surfaces which are not disfigured.

17.3 Glass shall conform to the quality, thickness and dimensional requirements specified in US Federal specification DD- G 0451 C.

17.4 Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm within 260 mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripples shall be consistent and extent shall be acceptable to Architect. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional as per Architect's option. Surface compression stress of heat strengthened glass shall be within 320 – 450 Kg/cm2

17.5 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Architect. All glass shall be delivered to site with the manufacturer's label of identification attached.

17.6 Submit for Architect's approval a complete list of materials to be used, including the sealants proposed and such samples as the Architect may require. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall be as approved and recommended in writing by the applicable glass and sealant manufacturers. A sealant substrate test report shall be submitted for each type of sealant for adhesion and compatibility.

17.7 Sealants in factory-glazed panels shall be fully cured prior to shipment to projects site and installation.

17.8 All glass breakage caused by the Contractor or his sub-contractor because of the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

17.9 The Contractor shall be responsible to deliver to the Employer without charge replacement for any unit of glass and glazing that fails within the Guarantee period of Ten (10) years from date of completion of Contract.

17.10 The glass glazed panels / structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirements of local building codes.

17.11 Glass thickness should be selected in accordance with AS 1228 – 1989 "Glass in Buildings Selection and Installation" to satisfy design performance requirements and local design codes.

17.12 Glass shall be free from defects or impurities detrimental to its performance. Defects such as bubbles, waves, spots, scratches, spalls, discolouration, visibly imperfect coating, chipping, and bubbles or delamination of opacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour.

17.13 Manufacturer's glazing instructions regarding installation, clearance, dimensional tolerance, bite edge clearance etc. shall be followed.

17.14 All solar control glass panels shall be stored with particular care and protected against abrasion, sun and moisture prior to installation.

17.15 Precautions specified by glass manufacturers to minimise thermal stress must be followed. A thermal stress analysis shall be obtained from glass manufacturer prior to fabrication and their recommendations shall be followed. Allowance shall be made for thermal movements due to an air temperature range of 60°C (+100C-700C) and a material temperature range of 100°C.

17.16 Glass panels shall be selected / rejected on the basis of product quality standards specified by the manufacturer concerning scratches, pinholes, clusters, distortion, colour variations, flaws in coating and other defects.

17.17 Each type of glass shall be obtained from only one manufacturer and one lot. Adequate spare quantity shall be ordered to cover for breakage and for replacement during maintenance period.

17.18 Setting blocks for glass shall be extruded neoprene with minimum 80 durometer hardness.

17.19 VISION GLASS PANELS;

Characteristics of each type of glass are given elsewhere.

17.20 SPANDREL GLASS PANELS

Characteristics of each type of glass are given elsewhere.

18.0 GLAZING COMPOUNDS;

18.1 Provide documentation as per Item 7.1. All neoprene materials shall be extruded high quality ozone resistant, cured, elastomeric, virgin neoprene compounds with durometer hardness, profiles and design parameters, lengths and locations all as required and recommended in writing by the applicable glass manufacturer (s). All neoprene glazing materials shall have smooth neat exposed surfaces, all flashings and burrs removed and in profiles, including integral locking projections to engage into the parent drawings. Furnish certified test reports to establish conformity with the specified standards.

18.2 Setting blocks used to support the dead load of the glass shall be extruded in silicone material conforming to the design criteria, all as recommended by the glass manufacture. Jamb shims used to centre and station the glass shall be extruded in silicone material conforming to the design

18.3 Fixed compression and roll-in glazing gaskets shall be extruded in silicone material as recommended by the glass manufacturer. Gaskets for any one light shall be one piece with injection moulded corners free of all flashings and burrs.

19.0 METAL COATINGS:

19.1 All Aluminium extrusions shall be PVDF coated to minimum 35 microns of shade approved by the Architect.

19.2 Coatings to aluminium sections and cladding where specified shall be fluoropolymer formulated and will consist of a 3 coat system comprising primer, colour coat and clear anti abrasion top coat. The coating system shall meet or exceed all the requirements of AAMA 605 - Voluntary specification for high performance organic coatings on Architectural extrusions and panels.

The total dry film thickness shall be 35 microns.

19.3 After selection of colour by the Architect, the Contractor shall prepare two (2) sets of two (2) samples of each which shall define the colour and gloss range and submit them for approval.

19.4 All samples shall be identified and have a full laboratory report attached.

19.5 The coating system, including materials and application shall conform to the requirements and recommendations of the paint manufacturer.

19.6 Testing and Sampling Procedures

In-process testing shall be performed on test specimens of equal metal thickness pretreated and finished along with the production metal, specimen shall exhibit a test of at least 75 mm x 300 mm to permit instrument readings. In addition to running in-process tests to assure high quality production, additional finished extrusions or panels are to be submitted to the coating manufacturer's laboratory for extended exposure testing. All test samples shall be properly identified with date, batch number and shift indicated. The following tests shall be conducted at least once per production shift and submitted to the Employer when required.

(i) Dry Film Thickness – evaluated with a Permascope, Isoscope or Dermatron instruction.
(ii) Film Hardness.
(iii) Dry Cross batch Adhesion (iv) Boiling Water Adhesion Test.
(v) Gloss Measurement
(vi) Colour Examination Against Standard
(vii) General Appearance – Smoothness, free of blisters, sags, pinholes and other surface imperfections.

Testing reports shall be certified by the testing agency, manufacturer and the Contractor

19.7 Process

(i) Dry Film Hardness – The coating shall have a hardness of H minimum when tested with "Eagle Turquoise Pencil"

(ii) Film Adhesion – The coating system shall withstand the following adhesion tests:

DRY: Make ten (10) parallel cuts 1.25 mm apart through film and ten (10) more cuts 90 degrees and crossing first ten cuts. Apply Scotch Transparent #710 Tape, 18m wide, over area of cuts, pressing down firmly against coating. Pull tape off sharply.

WET: Make ten (10) parallel cuts as above. Immerse samples in boiling water for 5 minutes. Remove sample, dry, cool and tape-test the cross-hatched area as above.

iii) Gloss Measurement – Measure gloss at various locations on painted metal with a 60- "Glossmeter".

iv) Colour Uniformity – Check random samples of painted production metal under a uniform light source, such as natural North daylight against standard panels approved by the Employer.

v) Test for cure of coating using 100 double rubs with several thickness of cheesecloth wet with MEK solvent. Slight dulling of the film is considered normal, but softening shall not be permitted.

Performance Requirements:

Salt Spray resistance – withstand a minimum of 3000 hours exposure to 5% salt solution at 95%.R.H., 37.5 degrees C with no more than 1.25 mm creepage or loss of adhesion from scribed line or cut edges.

Humidity Resistance – Withstand a minimum of 3000 hours exposure to 100% R.H. 37.5 degrees C with no more than a few blisters, size No. 8 (ASTM D 714 – 56).

Abrasion Resistance – Withstand abrasion of sand with an abrasion coefficient value of 65 minimum when evaluated as per ASTM D 968-51 test method.

Mortar Resistance – Withstand wet mortar, 24 hour part test at 100% RH without gaining adhesion or any visual effect on the painted surface of solid colours.

Detergent Resistance – Withstand immersion in 3% synthetic detergent solution for 72 hours at 37.5 degrees C with no loss of adhesion no blistering and no visible change.

Colour Retention – Withstand maximum chalk rating of No. 8 for colours and No. 6 for white per test method ASTM D659-44 (1970).

Field Touch-up and Repair – The contractor and coating manufacturer shall supply materials for air dry touch up for spray or brush application as per instruction of manufacturer. Touch up shall be held to an absolute minimum to Architect's approval.

Furnish to Owner a written guarantee warranting all work in connection with organic coating system to be free from defects in materials and workmanship for a period of Ten

(10) years from date of completion and to correct promptly any defect free of cost. The following are considered as defects without being limited thereto:

i) Peeling ii) Cracking iii) Checking iv) Blistering

v) Chalking in excess #8 Chalk rating when measured in accordance with ASTM D659-44 (1965).

vi) Fading or colour change in excess of 5 NBS unit when calculated from measurement on a spectrophotometer or colour meter capable of colour measurement by reflectance reading in accordance with ASTM D244-68.

20.0 STRUCTURAL GLAZING AND CLADDING SYSTEMS

20.1 The method of assembly, reinforcing and anchorage of the aluminium structural glazing / cladding system, where indicated, is schematic. Locations and method of providing same shall be the Contractor's responsibility, who shall design the assembly, reinforcing and anchorage to suit each specified conditions in an acceptable manner complying with the requirements specified herein after.

20.2 Visible joints shall be as shown in the Architect's drawings.

20.3 All parts shall be secured by concealed means wherever possible and where exposed to view, screw positions are to be indicated on the preliminary drawings. Exposed screws shall be of the countersunk type coloured in same finish as of aluminium or non magnetic stainless steel and shall be evenly and neatly located in an approved manner.

20.4 All components shall be assembled, secured anchored, reinforced, sealed and made weather-tight in a manner not restricting thermal or wind movements of the structural glazing. Sealants shall be concealed wherever possible.

20.5 All fastening into or through aluminium shall be SS-306 as approved by Architect.

20.6 Free and noiseless movement of all the components of the Curtain Walling system due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, shall be achieved without strain to the glass, without buckling of any components and without excessive stress to any members or assemblies.

20.7 Aluminium surfaces in contact with mortar, concrete, plaster, masonry, wet application of fire-proofing and absorptive materials shall be coated with an anti-galvanic, moisture barrier material.

20.8 Waterproofing:

a) A complete drainage system must be incorporated into the structural glazing frame work. Water leakage and condensation shall be drained or discharged to exterior face of the wall and all internal spaces vented by acceptable means to ensure air pressure equalization wherever possible.

b) Drainage system will be sealed off at every floor to prevent infiltrated water from leaking to lower floors.

c) Movement of water behind and on exposed surfaces must be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to avoid the potential for algae and fungus growth as a result of standing or trapped water.

d) The junction of bracket connecting S.S.Screen with reflector system & structural Glazing system shall be fully protected against ingress of water by providing suitable water proofing systems as approved by Architect.

20.9 Anchorage System and Building Frame

Each glazed unit shall be fixed to the structural slab at each floor level. All fasteners shall be SS-304 of AISI as approved by Architect. The contractor shall also make necessary modifications to the anchor fasteners to suit existing site conditions of steel reinforcement without additional charge.

20.10 Mullions and Transoms

a) The sections of mullions and transoms shall be designed to restrict deflection under wind pressure as specified and shall be rigid enough to support and retain the glass spandrel under all conditions. The mullions shall be designed if required, to act as guide

tracks for gondolas to permit its free movement in vertical direction for window washing and to sustain concentrated loading by the gondola cage. The mullions & transoms shall also to be designed to cater for the loading of S.S Screen with reflector.

b) Reinforcing members, where used, shall be completely enclosed and if fabricated from steel shall be galvanised and protected with primer and two coats of zinc chromate.

20.11 Window units (Vision Panels)

All windows shall be glazed from inside where possible. All cladding as well as internal glazing beads, if any (unless otherwise specified) shall be in anodised aluminium.

20.12 Spandrel Units

a) Spandrel shall be of glass having equal colour matching with vision areas with opacifier coating.

b) Structural spandrel beam, structural glazing fasteners and other construction shall not be seen through the glass from the exterior and shall be fully concealed behind shadow box.

c) A shadow box shall be provided a distance behind the spandrel glass panel. It shall consist of 50 mm semi–rigid fibre glass insulation of minimum density of 48 Kg/cum., and 0.8 mm galvanised sheet steel tray natural finished. The periphery shall be properly sealed. Surface #1 shall be adequately protected against damage until spandrel glazing is done.

d) Two hour rating fire stops–cum–smoke seals shall be constructed continuously at the spandrel to the approval of the Chief Fire Officer and other authorities.

20.13 Ventilators, Openable Windows and Doors

a) Ventilators, windows and doors shall be provided at positions as shown on the drawings. The ventilators when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified.

b) All hardware and accessories shall be supplied by the contractor and when exposed shall be of stainless steel or approved aluminium alloys in approved finish.

c) Minimum aggregate openable area of the ventilator shall be as given in the Architect's drawings.

d) The detailed system of the ventilators and doors must be proposed by the tenderer keeping the position as shown on the drawings.

20.14 Coping and Soffit Trimmer

a) All coping and soffit panels shall have suitably designed frame reinforcement and be fixed rigidly to the structure.

b) All joints between coping / soffit panels and between coping / soffit panels to structural glazing frame and other sections of the work shall be tightly sealed up. Effective drainage system shall be provided to drain out the water that may penetrate through the joints.

20.15 CLADDING

Cladding shall be non-toxic composite aluminium panels of adequate strength with approved aluminium details. The panels shall be 4 mm thick composite units finished with PVDF coating minimum 35 micron thick of approved metallic colour. The resin content of the PVDF coating shall be minimum 75%. The back of the panel shall be chromatised minimum 3 micron thick, compatible with adhesives for stiffeners if any or given a polymer coating. The insulation fill of the composite panel shall be non-toxic on

burning and panel shall be acceptable to CFO. The fabrication and installation of the cladding systems shall be carried out as per manufacturer's instructions with invisible / concealed fastenings, aluminium sub-structure, silicon sealants properly tooled etc.

All cladding panels of one kind shall be obtained in one lot from the manufacturers. Each panel shall be guaranteed for a minimum flatness of ±1 mm from the true face after installation under no-wind conditions.

Deviations from the true alignment of adjoining panels shall not be cumulative. Full load deflections shall be kept to the minimum possible. Each panel shall be capable of withstanding wind pressure without any permanent deformation.(Refer clause27.0 on page TS-Str. Glazing -53.) The cladding system shall be adequately ventilated. The airgap between the cladding panels and the concrete / block wall shall be atleast 50 mm to allow proper ventilation of the rainscreen system. The cavity shall be closed by a perforated bird / vermin-proof closer at bottom and by a flashing at top.

The fabrication processes including cutting, grooving, benching, folding, joining, rout-in as well as installation shall be performed as per manufacturer's instructions. The panels shall be backed by approved aluminium supporting framework, fixed to walls with aluminium brackets.

21.0 LOUVERED PANELS

21.1 Louvered panels shall be provided at positions as shown on the drawings.

21.2 Louvres shall be of 35 micron PVDF coated of approved shade aluminium fins of Aerofoil shaped blades of Min 1.5 mm thickness with an assumed efficiency of 50% unless otherwise specified and shall be complete with stainless steel bird-proof wire mesh (18 gauge) fixed internally.

21.3 All hardware and accessories shall be, when exposed, of non-magnetic stainless steel and / or coloured aluminium to match that of structural glazing / cladding wherever possible.

22.0 FABRICATION

22.1 General: All assemblies shall be fabricated and assembled in accordance with the drawings and the requirements of these specifications. Deviations of any nature, without approval of the Architect /PMC shall not be permitted.

22.2 Tolerances: Furnish a schedule of fabrication tolerances for all major wall cladding components. In addition to the fabrication tolerances, provide for and schedule thermal movement including assembly and installation tolerances for all major and/or applicable wall cladding components and/or assemblies.

22.3 Workmanship

1) All work shall be performed by skilled workmen, specially trained and experienced in the applicable trades and in full conformity with the applicable provisions of the listed References and Standards and/or otherwise noted on the drawings or as specified herein.

2) All work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and design criteria.

3) All forming and welding operations shall be done prior to finishing. Unless otherwise noted.

4) All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, waves or flaws of any nature impairing strength or appearances; fitted with proper joints and intersections and with specified finishes.

5) All work shall be erected true to plumb, level, square to line, securely anchored, in proper alignment and relationship to work of other trades and free from waves, sags or other defects.

22.4 Joints in Metal Work

1) All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise shown or required for thermal movement, shall be accurately fitted, rigidly secured with hairline contacts and sealed watertight.

2) Where two or more sections or metals are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any point materials. Extrusions shall be finished to eliminate any edge projection or misalignment at joints. Furnish physical samples of all joinery elements as for comparative appraisal and approval of the production materials. Physical samples of all typical wall intersection assemblies shall be colour coded on surfaces and/or areas to receive sealants.

22.5 Shop Assembly

As far as practicable, all fitting and assembly of the work shall be done in the shop. Work that cannot be permanently shop assembled shall be temporarily assembled in the shop and marked with the approval of Architect, before disassembly to ensure proper assembly later in the building.

22.6 Sleeves

Unless otherwise noted, all aluminum sleeves shall be extruded sections designed to accurately interlock with adjacent sections and incorporate serrated surfaces for the secure bedding of sealant between the parent metal and the sleeve.

22.7 Fasteners

1) All fasteners shall be of SS-304 of AISI stainless steel with self locking devices, unless otherwise specified, and of sufficient size and strength to withstand the applicable design wind load and dead load forces with safety allowance factors as required for the specific materials. The spacing and quantities of fasteners shall be as required to develop the maximum strength of the member they secure or support. Washers and/or other accessory items shall be of the same material as thee fastener. Torque tightens all assembly fasteners to achieve the maximum torque tension relationship in the fastener. 2) All fasteners shall be concealed unless otherwise shown or approved. The head style for all exposed fasteners shall be countersunk oval head unless otherwise specified on the drawings. Exposed fasteners shall be finished to match surrounding metal finish. 3) All fasteners including washers and accessory items shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all fasteners conform to the designated and approved type, size, material, spacing,

etc. When certain items are not readily apparent, such as material and alloy or torque tightening requirements, special instructions for the identification and appraisal of such items shall be issued.

22.8 Protection of Metals

1) Protection against galvanic action shall be provided wherever dissimilar metals are in contact.

2) Aluminium which is to be in contact with cured concrete, mortar or plaster shall have the contact surfaces protected wherever crevices between the contact surfaces may entrap moisture and corrosive elements. All metals, except stainless steel, which are to be in contact with fresh concrete, mortar or plaster, shall have the contact surfaces protected with epoxy paint.

3) Furnish a schedule of all protective coatings and related items including the designation of area and/or specific locations, materials used, special instruction, specification data sheets, etc.

22.9 Welding

1) All welding in aluminum work shall be done by the inert gas shielded arc or fluxless resistant techniques and with electrodes and/or by methods recommended by the suppliers of the metals being welded. Type, size and spacing of welds, shall be as shown on approved shop drawings. Welds in galvanized metal shall be touched up with zinc rich paint.

2) Welds behind finished aluminum surfaces shall be so done as to eliminate distortion and/or discolouration on the finished side. When required, weld spatter and welding oxides on finished surfaces shall be removed by de-scaling and / or grinding.

Provide low heat filled welds using chill bar on finished side to eliminate dimpling, distortion and / or discolouration on the finished or exposed surface. Plug, puddle or spot-welding are not permitted. If weld beads are shown on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.

3) Structural welds shall be made by certified welders and shall conform to the general recommendations and regulations of AWS Specification D1.0-46.

a) Dirt grease, lubricant, or other organic material shall be removed by vapour degreasing or suitable solvent.

b) Joints rejected because of welding defects may be repaired only by rewelding.

Defective welds shall be removed by chipping or machining.

Flame cutting shall not be used.

4) Wherever welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

5) All welds shall be scheduled and designated on the shop drawings so that anyonecan witness and assess the assembled units to ensure that all welds conform to the designated and approved type, size, spacing etc.

22.10 Soldering

All soldering and/or brazing shall be done as recommended by the suppliers of the metals involved.

22.11 Shop painting of Carbon Steel

Item of carbon steel, unless galvanised or scheduled for other finish, shall be thoroughly cleaned of all loose scale, filings, dirt and other foreign matter and shall be painted with zinc chromate primer.

22.12 Factory Application

As much work as possible shall be carried out in the factory. All glazing shall be done in the factory. Gaskets shall be pre-positioned and welded in the factory as far as possible. Site work shall be kept to a minimum.

23.0 GENERAL EXECUTION

23.1 The drawings supplied by the Architect shall be considered essentially schematic, except of profiles of exposed surfaces which shall be as indicated. If, in the opinion of the contractor, a change of profile is required in order to meet the specifications, he shall consult the Architect for a review of the conditions.

23.2 The method of assembling, reinforcing and anchorage of the aluminum structural cladding system, were indicated is schematic. Location and method of providing same shall be the Contractor's responsibility, who shall design, assemble, reinforce and anchor to suit each specified condition in an acceptable manner complying with main building structure. Site work shall be coordinated with the Overall programme.

23.3 Visible joints shall be as shown on the Architect's drawings.

23.4 All parts shall be secured by concealed means and screws exposed to view shall not be allowed.

23.5 All components shall be assembled, secured, anchored, reinforced, sealed and made weather tight in manner not restricting thermal or wind movement of the metal wall cladding /curtain walling system. Where possible, sealants shall be concealed.

23.6 Free and noiseless movement of all components of aluminum structural glazing and cladding system due to thermal, structural, wind pressure, or dead loads shall be achieved without strain to glass, without buckling of any components and without excessive stress to any members or assemblies.

23.7 The entire aluminum structural glazing and cladding system shall be assembled and installed so that all leakage and condensation shall be drained and discharged to the exterior face of the wall.

23.8 Movement of water behind and on exposed surfaces shall be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapping water.

23.9 Measurements:

The measurements given on Architect's drawings shall not be used by the Contractor for preparing his shop drawings and for executing the work. All dimensions shall be actually measured on site and in case of any discrepancy between measurements on site and in drawings, modules shall be decided in consultation with the Architect.

24.0 PRE-CONSTRUCTION LABORATORY PERFORMANCE TESTING.

24.1 General

Specification 24.1 to 24.7 shall apply and the Contractor is required to carry out performance tests in laboratory condition at one of the approved test laboratories at his own cost if specifically mentioned in the Bill of Quantities.

The performance mock-up are full-size representative portion of the proposed exterior wall system built to study construction details, test for the whole system meeting the performance specification for weather , structural load and movements.

The Contractor shall carry out on site water penetration test at locations as specified in clause 24.8 at his own cost.

The contractor shall produce Mock-up Elevation, construction detail drawings and structural calculations for the structural glazed curtain wall mock-up test units and submit to Architects office for the final approval. The Contractor shall forward the copies of approved mockup elevation and shop drawings and test parameters to the Test Laboratory prior to installation of the test units. These drawings shall include:

- Test elevation and sections showing bracket spanning.
- Full scale typical details of unitized panels (intersections of members).
- Typical support details and spanning.
- Extent & type of sealants: weather and structural sealants.
- Pressure equalization and Drainage system in each panel with size.
- Blanking off details and spandrel panel pressure release .
- Openable vent details with multipoint locking positions.
- Method of installation.

Any deviations from the drawings shall agreed upon before commencement and recorded in the final test report. Contractor shall install the mock-up in line with the approved drawings and with the same supervision and installation work force.

24.2 Test Units

1) The test units shall comprise of components and full size representative portion of the proposed exterior wall system under examination. The width of the test sample shall be not less than three typical elements / units. The height of the test sample shall be not less than 2 storey high and must contain full height modules of the proposed structural glazing system. Vertical and horizontal movement joints shall be included in the test sample.
2) Critical details of the building facade which differ from those in the representative test sample, such critical inward and outward building corners, overhangs, copping seal at roof level and similar , supplementary on site test for water tightness shall be performed on such part of the facade.
3) The materials and components of the test sample (glass thickness, size and strength, aluminum profiles, bracket spanning, sealant, gaskets, accessories etc.) shall be of the same, type and size and have the same details, methods of construction, flashing and anchorage as that of proposed on the building facade.
4) The cost of entire testing shall be borne by the Contractor.
5) The test sample shall be mounted and sealed into a simulated building frame in the manner and by the same fixing which are intended to attach the facade to the building structure. The support frame if not same but shall be of equivalent stiffness to that

supporting the building to prevent unrealistic deflection of the prototype sample. 6) Simulated floor slabs and spandrel shall be to actual depth as of site condition with the air seal connected to the slab. The air seal of the test sample shall be continued to the air seal of the test chamber.

7) All Unitized mock-up panels in the facade shall be sealed at the test chamber boundaries. This is to minimize the effects that the surrounding construction will have on the test performance of the sample. All pressure equalization and drainage slots or holes in the test sample shall be left open.

8) Transparent viewing panels shall be provided so that the performance of the façade in areas that are not readily seen can be determined.

24.3 Inspection of test units

1) The Contractor shall allow for the PMC's / Architect's / Employer's representative to inspect the test sample during erection. At this stage the adequacy and stiffness of the support structure shall be assessed. When the installation of the test sample is complete, the PMC's / Architect's / Employer's representative shall inspect the test sample and if satisfied, shall approve its completeness in writing.
2) Testing shall commence only after obtaining the written approval as referred above.
3) Full time supervision of the contractor shall be provided for the erection of the test unit and all thru testing of the test units.

24.4 TEST SEQUENCE- TEST PRESSURES

Prior to testing , unlock, fully open, close and lock operable windows, doors in the mockup for minimum of 5 cycles. If any repairs or corrections are made, repeat the above cycle for 5 times.

1) Air Infiltration Test (ASTM E-283)

Method :

The test shall be conducted at 300 Pa pressure.

The test chamber leakages shall be calculated by attaching air tight seal of polythene sheet to the face of the curtain wall with the tape and seal all around and applying Positive, negative pressures of 300 Pa to measure the air infiltration rate through the test apparatus by calibrated flow meter placed in the test chamber airline. Now sealing film or tape shall be removed from the test sample and the total air infiltration through the test sample and the chamber shall be recorded. The difference between the total leakages and the chamber leakage shall be the leakage of test sample. Evaluation : Permissible air leakage shall be: 0.25 m3/hr/m2 for fix area and 1.0 m3/hr/mtr crack length of operable panel.

2) Test Water tightness (Static pressure)

Method :

The differential air pressure for the test shall be 600 Pa. Water shall be sprinkled on the test unit at 3.4 L/m2-Min apply the air pressure differential within 15 seconds - negative pressure of 600 Pa shall be maintained continuously for 15 minutes before the pressure is turned to zero and stop the water spray.

Observation:
All water leakage and drainage system at the joints and ventilators of the Curtain Walling System shall be observed from the inside of the chamber.

Evaluation:
If water observed in the operable vent drainage path and the same is drained thru drain slots after the spray is stopped it shall be considered as pass.
Any uncontrolled water in excess of 15 ml or more on the top surface of any exposed interior shall be considered as leakage. In case of leakage the remedy needs to be carried out and the retest shall be conducted. 3) Test of Water tightness (Dynamic pressure)
Method:
This test shall be performed upon completion of the test for water penetration by static pressure. The Dynamic water penetration test should not commence within thirty (30) minutes of the static water penetration test. Maintaining the wind flow with the help of wind generating device, wind speed shall be adjusted to 31.28 m/sec, water shall be sprayed on the complete face of the test specimen at the rate of 3.4 Ltr/m2-Min.The spray shall be maintained for a period of not less than 15 min.
Observation:
Observation of the internal face of the facade shall be carried out during the water spray operation and for five (5) minutes after the water spray has stopped and there is zero air pressure different on the facade.
Any water appearing on the inside face of the facade shall be recorded, with the extent and, if possible, the source of leakage indicated.
Evaluation:
There shall be no leaks at the peak pressure equal to 600 Pa static positive pressure. A leak is considered to occur when:

a) Water appears on the inside face of the facade and is visible from an occupied space in excess of 15 ml of water or

b) Uncontrolled water appears on the inside face of the facade and is likely to damage insulation or other Architectural fixtures.

c) Uncontrolled water is defined as any leakage that is not contained and drained away within the test duration (including the five (5) minutes observation period) in excess of 15 ml of water.

4) Test of Wind Resistance under static pressure
Method :

The equivalent load for wind pressure or wind suction shall be given to the test unit as increasing and decreasing the inside pressure of the “Pressure Chamber” at which the test unit is fixed.

Static Wind Pressure : The static pressure shall be increased to a maximum of + 215 Kg/sq.m. in steps.

Observation : Deflection on each observational point of the test unit shall be observed and recorded under the static pressure as described above.

Evaluation : No damage or harmful permanent deformation on any parts shall be found at the maximum design wind pressure as defined in item 24.4. The deflection of the main structural members in this condition shall be as follows:

a) Mullions less than L/175 in case of single glass and L/240 in case of double glass (L = length between support) or less than 15 mm whichever is least.

b) Transoms Less than L/300 (L = length between support) or less than 15 mm whichever is least.

No damage or harmful permanent deformation of any parts excepts sealing materials shall be found at the maximum testing pressure.

The maximum deflection / span ratio of glass shall not exceed 1: 90. The residual displacement of a member shall not exceedL/1000. The slippage at supports and fixing shall not exceed 1.0 mm.

5) Seismic Racking test

Method : The floor beam shall be subjected to 3 cycles of Lateral Displacement up to the value of 0.4% of floor height With no time restrictions. First the beam will be jacked To one direction to the maximum limit of the Displacement and released to allow the system to come Back to its original position. The beam is than jacked to Other direction to the maximum limit and released. Like Wise 3 cycles are repeated.

Observation : The observation team is placed inside and outside The specimen to watch for any sudden effects of Jacking.

Evaluation : No glass breakage or fall out is allowed. Any damage shall be easily repairable without any part replacements required. No wall component fallout is allowed.

6) Repeat Air test : Same as described under air infiltration test with static pressure.

7) Repeat Water test static : Repeat the water penetration test under static pressure.

8) Proof test

Method : The test sample shall be subjected to proof tests. The applied positive and negative pressure shall be 1.5 times the designed wind pressure. Each proof test pressure shall be maintained on the test sample for a period of 10 seconds at peak pressure and released to zero.

Evaluation: Under proof test there shall be no collapse shall mean any one or any combination of the followings:

a) Dislodgment of any glass.
b) Dislodgment of any frame, panel or any thereof
c) Failure of any fixings that connect the façade to the building structure, such that the test sample is unstable.
d) Failure of any stop, locking device, fastener or support which would allow an opening light to come open.
e) The permanent deformation in framing members in excess of L/1000 is not permissible and considered as failure.

24.5 Form of Report

Details of the test sample (including an outline of the simulated building frame) and the test apparatus, instrumentation and method shall be clearly given in a report.

The report shall include the following:

a) An identification and general description of the facade and Certificate of Identity from the contractor.
b) Drawings of the actual test sample showing modifications, if any.
c) Test sequence with pressure used in all tests.
d) Location of all transducers for the structural performance test.
e) Displacements, span/deflection ratios and air infiltration rates.
f) Other pertinent observations.

24.6 Record Drawings

1) The testing laboratory shall keep a copy of approved test unit, shop drawings and calculations at testing laboratory accurately and neatly recorded on the above mentioned shop drawings all changes, revisions, modifications, etc. made to test unit, which shall become the record drawings.

2) On completion of testing and after approval of test reports, the testing laboratory shall submit the marked up record drawings to the Project Consultant.

24.7 Cost of Performance Testing

The cost of testing at the approved lab shall be payable as per relevant item as indicated in the Bill /Schedule of Quantities. Testing shall include for the test chamber, support structure for the test, cost of fabrication, erection, corrections to and the demolition of the test unit. If the test unit fails to pass the initial testing, the Contractor shall make the necessary corrections to the test unit and shall have the Test unit re-tested by the Testing laboratory until it passes the test. The rate shall also include for cost of correction to the test unit and cost of re-testing and no additional cost shall be payable in this regard.

24.8 Site Tests

The Contractor shall carry out site tests at his own cost to determine resistance to water leakage as per recommendations given in AAMA 501.2-94 and relevant Bureau of Indian standards for “Field Check of Metal Storefronts, Curtain Walls and Sloped Glazing Systems for Water Leakage”. The test areas shall be selected by the Architect, one for every 600 sq.m. approx. of installed curtain wall and glazing system.

Testing will normally be ordered on Lower floors but the Architect may at his discretion order tests to be carried out on any upper floor. In case of any test failing, the Architect shall order more tests to be conducted at the Contractor's cost.
Each test area shall be:

a) 10 sqm. minimum or
b) 25 m. Run of perimeter of vision and spandrel units
c) 4 entire panels of standard types, whichever is the least.

25.0 INSTALLATION

25.1 Quality Control : See clause 7.3

25.2 Qualification of workmanship

All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed References and Standards and/or as otherwise noted on the Architect's drawings or as specified herein. The qualification of the Contractor's installation workmen shall first be filled with and approved by the PMC / Architect.

25.3 Setting out

Bench marks for elevations and building line offset marks for alignment shall be established on each floor level by the contractor. Should any error be found in their location, the Contractor shall notify the PMC in writing and installation work shall not proceed in the affected area until the errors have been corrected.
The Contractor shall submit the structural glazing anchorage plan for endorsement by the PMC and approval by the Architect. The Contractor shall co-ordinate his system of anchorage with PMC according to site conditions.

25.4 Prior Inspection of the Structure

After the setting out has been established and before beginning installation in any area, the Contractor shall examine all parts of the structure on which the curtain walling system/metal wall cladding are to be placed in that area. Should any conditions be found which, in his opinion, will prevent the proper execution of his work or endanger its permanency, he shall report such conditions in writing to the PMC. Installation work shall not proceed in that area until such conditions are corrected or adjusted to the satisfaction of the PMC.

25.5 Workmanship

All parts of the aluminum structural glazing and cladding system shall be erected true to plumb and in proper alignment and relation to establish setting out, as shown on approved shop drawings.

25.6 Erection Tolerances

The installed metal wall cladding/curtain walling system components shall conform to the following erection tolerances under no-wind conditions:

a) Amount of total deviation and/or misalignment in any direction for vertical members: 3 mm maximum in a height of 4 m (non-cumulative) and maximum 7 mm in full- height of cladding/curtain walling.

b) Amount of total deviation and/or misalignment in any direction for horizontal members : 3 mm max. in a length of 7 m. 5 mm in full length

c) Maximum offset from true alignment between two abutting members shall be 1 mm. No edge projection or misalignment will be permitted.

d) Maximum joints, gaps or openings between removable glazing stop and adjacent member shall be 1mm and/or a maximum 1 mm cumulative opening at both ends of removable members (0.5 mm each end).

e) Deviation in spacing of brackets + 3 mm.

f) Allowances for the cumulative effect of all tolerances (fabrication, assembly, thermal and erection) must be made to ensure a workmanlike installation. The documentation and distribution of this information to all applicable installation and inspection personnel is essential in order to ensure the standard of quality and workmanship required.

25.7 Installation within and/or adjacent to concrete: Where work is to be installed within and/or adjacent to concrete, no aluminum structural glazing and cladding system components other than built in anchor devices shall be put in place until the concrete work is completed, including the removal of all forms, shoring, etc.

25.8 Anchorage: See clause 12.5 (2) and 20.9.

a) Anchorage of the aluminum structural glazing and cladding system to the structure shall be by approved methods and in strict accordance with approved shop drawings. After the aluminum structural glazing and cladding system are properly positioned, all connections so designated on approved shop drawings shall be rigidly fixed by welding or other positive means.

b) All anchorage assemblies and their related components shall be thoroughly scheduled and described on the shop drawings so that anyone can evaluate an installation and ensure its compliance with the contract documents. Designate trades responsible for furnishing and/or installing materials if other than the Sub- Contractor. Descriptive items shall include the access removal movement and tolerances of related building and the aluminum structural glazing and cladding system direction and magnitude of thermal expansion, materials, sizes, quantities and any special instruction as may be required. All primary aluminum structural glazing and cladding, anchorage assemblies inclusive of frame/structural mullion shall receive a 100% inspection.

25.9 Welding

All welding shall be done by skilled mechanics qualified or licensed in accordance with local building regulations. Welds and adjoining burnt area in prime coated surfaces shall

be thoroughly cleaned and painted with one coat of primer. Welds in galvanised steel shall be coated with one coat of zinc rich paint. Special care shall be taken to protect glass and other furnished surfaces from damage and to prevent causing fires.

25.10 Use of sealing materials

a) Sealing materials shall be used in strict accordance with the Manufacturer's printed instructions and shall be applied only by workmen specially trained or experienced in their use. Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter shall be completely removed from surfaces it will contact. Adjoining surfaces shall be masked when required to maintain a clean and neat appearance.

Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

b) The manufacturer(s) of the applicable materials shall, when required render technical assistance prior to the application of any sealant and witness the first applications as well as periodic site inspections thereafter. The contractor shall witness and document all inspections performed by the sealant manufacturer and provide close supervision of all workmen used to apply the sealant.

25.11 Coping and soffit trimmer

Installation of coping and soffit panels and field sealing between the copings and other trades shall be performed by the Contractor.

25.12 Tensioning of Bolts

All bolts shall be correctly tensioned. The tension shall be specified on shop drawings. At least 10% of bolts shall be mechanically checked for corrected tension.

25.13 Sequence of Installation

If so directed by the PMC, installation of the aluminum structural glazing and cladding shall be postponed in areas as designated by the PMC for a specified period of time so as to facilitate moving materials/equipment into and out of the building and installation of M&E (Mechanical & Electrical) fittings during construction. The Contractor's work is to proceed along guidelines and schedule as directed by the PMC.

25.14 Removal of Debris

All debris caused by or incidental to the installation work shall be promptly removed from the job site as the work progresses. Weep holes and drainage channels shall be unobstructed and free of dirt, rubbish and sealant.

25.15 Protection and Cleaning

a) The Contractor shall adequately protect all aluminum sections, glazing, cladding sheets, components and accessories from damage during shipment, storage, erection and after completion of the work by use of protective film/foil of approved nonstaining quality,

b) At such time as may be directed by the PMC, the Contractor shall remove all protective coverings and/or coatings and clean surfaces free of all soil and discoloration. Only those cleaning agents that are acceptable to the applicable aluminum, glass and

coating manufacturers shall be used and where doubt exists, spot tests shall be made to satisfy the PMC.

WATER SUPPLY & DRAINAGE SYSTEMS

CONTENTS

1.0 SCOPE

The scope of this section covers guidelines for the contractor on the specification and schedule of material and the general requirements. These shall be read in conjunction with the general conditions, technical specifications and bill of material.

1.1 SCOPE OF CONTRACT

The scope of work under this contract covers equipment, material, accessories and labour required for the specified works and to carry out the erection as specified and shown on the drawing and schedule of material.

Safety, good workmanship and quality are the prime requisites of the work covered under this contract. All the equipments, material and the work carried out shall meet the relevant codes, specification and the intents of specifications and the proper functioning of the systems and installation and shall be in correct lines, levels etc.

2.0 DIVISION OF WORK

The division of work/scope between the contractor and client or other agencies shall be as indicated in-section 2102 – Division of work.

2.1 STANDARDS & REGULATIONS

Each section indicates the Indian/International Standard Specification to be followed. It is the responsibility of the contractor to meet the statutory regulation, local codes and other relevant standards and specifications connected to his work being carried out as may be in force at the time of execution and/or addition of new requirement.

2.2 SPECIFICATION

The technical specification attached herewith gives general guidelines and minimum standards for equipments material and workmanship. However it is the responsibility of the contractor to meet the statutory provision and IS/local codes as may be applicable at the time of execution.

2.3 DEVIATIONS

Should the tenderer wish to deviate from the provision of specification and drawings, the same shall be indicated separately at the time of tender submission. In the absence of any deviation it is deemed that the tenderer is fully satisfied with the intents of specification and drawings and their compliance with the statutory provisions and codes.

However, the offer shall be strictly on the basis of tender specification and schedule of material. The offer for the deviated items shall be furnished separately against respective

item in tender. The deviation shall include the following to access the merit of such deviations.

a) Necessity for such deviation and its merit

b) Technical details along with literature

c) Commercial implication along with supporting calculation.

2.4 MATERIAL

The equipments and material shall meet the specifications and requirements indicated in the technical specifications covered under specific section and the relevant equipment data. The equipments wherever indicated shall be BMS compliant/compatible.
The makes of material shall be one of the recommended makes covered under Section makes of material.

2.5 WORKMANSHIP

Safety good engineering and workmanship, neat appearance etc. are the prime requirements of the contract to achieve the same. The contractor shall co-ordinate with the main contractor and other agencies during the progress of work and later adequate care before carrying out the work. Necessary approval shall be obtained from the site in charge before incorporating modifications, changes or deviation from the drawing approved for execution. Such deviations shall be immediately incorporated/recorded along with the approval of site in charge.

2.6 SCHEDULE OF WORK AND CONTRACT VALUE

The schedule of work broadly indicates the scope and quantity of work to be carried out based on the information made available and the quantities estimated from the reference drawings. The contractor shall estimate the exact quantities through site measurements and from drawings issued before ordering the materials and update them during the progress of work.

The above quantities and the scope of work shall be subject to variation during the progress of work due to site condition, additional requirements or any other reasons. Also deletion or replacement of items and additional items may arise during the progress of work for augmentation or betterment of installation and change in the basic planning of the project. The above changes can result in the variation in contracted quantities. Such variations shall not alter the unit rates accepted, subject to the impact on the total contract value is within 25%.

Addition work, if required, shall be carried out during the progress of work, the rate for the same shall be derived from tendered item or total cost to the contractor plus 20% against overhead and profit.

3.0 REFERENCE DRAWINGS

The drawings issued with the tender are basic diagrammatic drawings and are part of the tender document. Based on this contractor shall prepare correct technical drawings and submit for Consultant's approval. Contractor shall preserve one set of this drawing in good condition incorporating all modifications carried out from time to time during the erection period at the site and shall incorporate them and submit to the Consultants/Clients after completion of the work.

3.1 WORKING DRAWINGS/SHOP DRAWING

Contractor shall submit the following details within 15 days of award of contract. a) List of equipments and the power requirement

b) Technical literature and catalogues of all equipments and material

c) Foundation drawings and structural support details for equipment to be carried out by the Civil contractor/others.

d) General arrangement, schematic power and control diagrams of electrically operated equipments and appliances along with control scheme write-up.

e) Detailed CPM/Pert chart indicating the supply and erection of equipments and material based on the construction schedule along with the probable date of supply of material by clients/work of other agencies.

f) List of activities that are expected to be completed by client/others

The contractor shall prepare execution drawings and get them approved prior to taking up of execution work. The execution drawings shall cover but not limited to the following.

a) Layout drawings duly co-ordinated with other services indication dimensions, sizes, weights and co-ordinates.

a) Detailed section drawings indicating levels and profiles, suspension arrangements, etc.

b) Engineering details fit for execution duty certified for structural safety by competed/qualified person.

c) Details and spacing of equipment mounting, equipment connections, supports and hangers.

e) Statutory clearances required, isolation and dismantling accessories to be provided at the equipments for easy operation and maintenance. f) Material specifications

g) Shop drawings of equipments, ancillaries and control panels and switchgears etc. including physical dimensions, schematic distribution, control wiring etc.

The approval of drawings does not relieve the contractor of their responsibility of meeting the intents and requirements of the specification and statutory requirements. He should also ensure suitable technical feasibility of all such works as per required standards.

3.2 AS INSTALLED DRAWINGS

The contractor shall prepare as installed drawing on completion of the work incorporating all modification, changes and deviations carried out on the execution drawings. The contractor shall submit 4 sets of hard copies and 2 sets of Autocad soft copies in CD at the time of commissioning and handing over.
The final payment against commissioning shall be effective only after submission of the as installed drawings.

4.0 MEASUREMENTS AND PAYMENTS

The mode of measurement and payment shall be strictly indicated under Section measurements and payments. This indicates the mode of measurement, items to be included and items excluded etc. in a broad basis. However, it is the responsibility of the contractor to meet the intents of the specification and total installation on the works contract/ turnkey basis.

4.1 INSPECTION

The Consultants/Clients shall have the right to inspect the equipment's, material and the workmanship during various stages of manufacturing storage and erection.
The contractor shall at their cost, make necessary arrangements for such inspection. Also the Consultants/Clients shall have access to the store of the contractor for such inspection.
The Consultants/Clients shall reject the material if found substandard or not meeting the specification and statutory requirements.

4.2 TESTING & COMMISSIONING

The contractor shall carryout in house, inspection, testing and commissioning of the equipments and the entire installation at various stage and submit the report for the scrutiny of the Consultants.
The contractor shall provide necessary instruments, appliances, loads and manpower required for the testing and demonstration of the performance of equipment and installation at site, manufacturer's work or elsewhere at various stages of manufacturing, pre-installation or post installation as required by the Consultants. These instruments and appliances shall be got tested and calibrated for their accuracy and performance by competent authorities.
The contractor shall, in the presence of clients, carry out precommissioning, testing and balancing of the system and incorporate necessary rectification before the installation is offered for taking over. Four sets of test reading shall be submitted for the scrutiny of the Consultants.
The installation shall be taken over after the final testing and commissioning of the equipment and entire installation in the presence of Consultants/Clients.
The Consultant/Client shall have the right to witness the testing of the equipments at the manufacturer's work and reshipment inspection. The contractor, at their cost, shall arrange such inspection.

The inspection and testing carried out by the Consultants/Clients or third party does not relieve the contractor of their responsibility of carrying out routine inspection and testing during each stage of procurement, manufacture and installation and also meeting the intents and requirement of the specification and statutory requirements.

4.3 STATUTORY INSPECTION

The contractor shall be fully responsible for meeting all the statutory obligations and local inspectorates pertaining to the works carried out by them. It shall be contractor's responsibility to liaison with the concerned authorities for obtaining supply of connections/permissions, all documentations as well as statutory visit by authorities before commencement/during construction and should be embodied in the tender price.

4.4 HANDING OVER

The installation shall be handed over after a satisfactory testing & demonstrating post installation. Contractor to bring all equipments/appliances/electrical load and engineer to demonstrate all readings for all items for the specs. before execution including stress testing along with the following documentation.

a) 4 sets of prints of the as installed drawings along with tracings/CDs
b) 4 sets of test reading and certificate of local authorities duly certified.
c) 4 sets of detailed equipment data and operation and maintenance manuals including one original
d) Manufacturer's warranty
e) List of recommended spares
f) Performance guarantee in the prescribed form including financial - 2 year warranty full replacement.

The final acceptance shall be effective only after the submission of the above documents.

4.5 PERFORMANCE GUARANTEE

All equipment and the entire installation shall be guaranteed to yield the specified ratings and design conditions plus/minus 3% tolerance for a period of 5 years from the date of handing over. Any equipment found short of the specified ratings by readings shall be rejected.

4.6 COMPENSATION FOR SHORTFALL IN CONTRACT RATINGS

The ratings/capacities of the plant offered at the time of tender are subject to realization during the performance tests. In case, the capacity rating of the chiller packaging established during the performance tests fall below 3% of the contract capacity/ratings, the Employer shall recover for such shortfall in capacity as given hereunder:

i) Shortfall of every percentage or part thereof, 10% of the cost of package, cost include supply, installation, testing and commissioning inclusive of all taxes, duties,

levies etc. and consumables.

ii) If the shortfall is more than 5% (excluding the tolerance of 3% mentioned above) the Employer reserved the right to insist on replacement of the machine.

4.7 COMPENSATION FOR EXCESS POWER CONSUMPTION

The tenderer shall substantiate power consumption rating furnished in the tender by means of T - θ, PH diagram and other theoretical calculations. The same will be scrutinized and accepted, if found reasonably correct. However, the same shall be realized during actual performance tests at site (subject to tolerance of +3% of the contracted 1kW/TR). If the power consumption exceeds the contracted ratings, compensation for not meeting the contract rating shall be recovered by the Employer form the contractors bill.

4.8 OPERATION AND MAINTENANCE

The contractor, if required, shall submit their offer for annual operation and maintenance of the plant and installation based on lumpsum or manpower basis. The rates shall be for

8 hour shift and shall include all charges viz. material, manpower, transportation, handing charges, taxes and duties.

The annual maintenance charges shall be applicable only after the defects liability. The breakdown time shall be limited to 2 hours for minor fault and 24 hours for major fault. Necessary extension shall be provided for special cases if found necessary. Penalty, if any, shall be applicable for delay in breakdown calls as indicated in the General/Commercial conditions.

4.9 DIVISION OF WORK

Scope under this section the division of work between the contractor and others on a broad basis, both supply of material and installation.

The details of material to be included in the supply items as well as installation, testing and commissioning of the system are covered under respective section and measurements and payments.

The scope of work of the contractor for installation of equipments and material supplied by the clients covers:

a) Taking delivery of material, storage and safe custody till handing over.
b) Transportation to the site of erection.
c) Supply of all fixing material, supports and accessories.
d) Supply of consumables for testing and commissioning.
e) Maintaining register of material received and utilised.
f) Hand over excess material.

5.0 EQUIPMENTS

The scope under this section shall cover the specification and details of equipments.

The equipment shall conform to the relevant standards and specifications indicated under each section.

5.1 STANDARDS

The following standard specifications shall be applicable.

a) IS : 1520 Horizontal centrifugal pumps for clear cold fresh water
b) IS : 1710 Vertical turbine pumps for clear cold fresh water
c) IS : 5659 Pumps for process water
d) IS : 9137 Code for acceptance test for centrifugal, mixed flow and axial pumps-class C.
e) IS : 10981 Code for acceptance test for centrifugal, mixed flow and axial pumps- class C
f) IS : 10596 COP for selection, installation, operation and maintenance of pumps for industrial applications.
g) IS : 9542 Horizontal centrifugal monoset pumps for clear, cold, fresh water
h) IS : 8034 Submersible pumps

5.2 GENERAL REQUIREMENTS

The pumps assembly shall be direct driven suitable for clear fresh water of temperature range 5C to 80C and shall be complete with pumps, motors, shafts, seals, coupling, glands, mounting frame fixing accessories etc. and shall conform to equipment data.
The pumps shall be single suction monoblock or double suction horizontal split case as indicated in the equipment data and bill of material. The pump shall deliver the required water quantity at the pressure head indicated. The capacity of motor indicated is only a guideline and shall meet the duty specified.
The pump selection shall be done to achieve lowest power consumption based on the QH chart of different models. The velocity of suction pipe should not exceed 1.5 m/s.

6.0 SANITARY APPLIANCES & FITTINGS

6.1 SCOPE

The scope under this section shall cover the specification and details of sanitary appliances and fittings.
All sanitary appliances and fittings shall be new, of best quality and one of the recommended make and model specified.
All appliances and fittings shall be with ISI approval mark and without any defects.

All ceramic appliances and accessories shall be vitreous glazed china wears of white colour unless otherwise specified. All appliances shall be complete with all accessories and fixing materials.

All sanitary fittings shall be heavy duty brass with chromium plating on exposed surfaces. The fittings shall be complete with all accessories, wall flanges etc.

6.2 STANDARD SPECIFICATIONS

The standard specifications shall be as follows :

a) IS : 2556 Specifications for vitreous sanitary appliances (vitreous china)
Part 1 General requirements
Part 2 Specific requirements of wash-down water
closets. Part 3 Specific requirements of squatting pans
Part 4 Specific requirements of wash-basins
Part 5 Specific requirements of laboratory sinks
Part 6 Specific requirements of urinals
Part 6/sec 1) Bowl type
Part 6/sec 2) Half stall urinals
Part 6/sec 3) Squatting plates
Part 6/sec 4) Partition slabs
Part 6/sec 5) Waste fittings
Part 6/sec 6) Waster spreaders for half stall urinals
Part 7 Specific requirements of half round channel
Part 8 Specific requirement of siphonic wash-down water-closets
Part 9 Specific requirements of bidets
Part 10 Specific requirements of foot rest
Part 11 Specific requirements for shower rose
Part 12 Specific requirements for floor traps
Part 13 Specific requirements of traps for squatting pans
Part 14 Specific requirements of integrated squatting pans
Part 15 Specific requirements of universal water-closet
IS : 771 Specification for glazed fire clay sanitary appliances
Part 1 General requirements
Part 2 Specific requirements for kitchen and laboratory sinks
IS : 2548 Specification for plastic seat and covers for water closets
Part 1 thermostat seats and covers
Part 2 Thermoplastic seats on covers
IS : 2326 Specification for automatic flushing cisterns for urinals
IS : 774 Specification for flushing cisterns for water closets and urinals (other than plastic cisterns)
IS : 7231 Specification for plastic flushing cisterns for water closets and urinals

6.3 INDIAN WATER CLOSETS

The Indian water closets shall be Orissa pattern squatting pans conforming to IS : 2556 part 14 shall have a minimum size of 580x440 mm. The WC shall be complete with self draining flushing rim of box with adequate number of discharge holes, supply horn, weep hole, anti stip foot rust etc. The pans shall be preferably with integral P-trap. The exterior surface of the outlet shall be rough, non glazed to achieve proper bonding between the WC outlet and pipe.

6.4 WASH DOWN (EUROPEAN WATER CLOSET)

The European water closet shall be sitting pan of one piece construction with S or P trap conforming to IS : 2556 Part 3, and having a minimum size of 550x345x390 mm. The European WC shall be with or without flushing tanks and shall be with inlet horn, self draining flushing rim of box with adequate discharge holes, weep holes, anti syphonage ven horn etc, The European WC shall be floor mounted or wall hung as indicated in the drawing and schedule of material. The wall hung European WC's shall include CI supporting chairs. The European WC's shall be with hinged plastic seats and cover.

6.5 URINALS

a) Lipped Front Urinal: The urinal shall be of flat back lipped front basin of required dimensions of white vitreous chinaware of an approved make as specified . It shall be fixed in position by using rawl plugs embedded in the wall with screws of proper size or fixed as per approved Manufacturer's specification. Each urinal shall be connected to a 32 mm N.B. PVC waste pipe with clamps which shall discharge into a channel or floor trap, or as specified.

b) Painting: The inside of the invisible portions of the fittings and brackets connected with urinal basin shall be painted with approved bituminous paint and outside of the brackets, etc. shall be painted with a priming coat of red oxide to give an even shade to match the colour of surrounding walls. The cost of such painting shall be included in the rate quoted for the concerned tender items.

The urinals shall be of bowl/flat back one piece construction conforming to IS : 2556 Part with integral flushing box rim adequate discharge holes, inlet and outlet horns.

6.6 SQUATTING PLATE

The squatting plate shall be of single construction conforming into IS:2556 Part 6 having a minimum size of 450x350x100 mm with integral long individual flushing pipe, non steel foot rest, 3 nos. 13 mm drain holes etc.

6.7 SEATS & COVERS

The WC seats and covers shall be of plastic conforming to IS : 2548 having a minimum of 3 mm thickness at the thinnest point. The seats shall be closed type with minimum 3 nos. rubber or plastic buffers of 25x40x10 mm. The cover shall be with equal no. of buffers placed right over the seat buffers. The seat and covers shall be smooth non absorptive and inert to household cleaners.

6.8 WC FLUSHING APPARATUS

The WC cisterns or flushing tanks shall be low level or high level plastic or vitreous china ware of minimum 15 litres capacity conforming to IS : 774 and IS : 7231. The flushing cistern shall be with siphonic apparatus, ball valve, over flow etc. The outlet size shall be 32 mm for low level and 40 mm for high level cistern. The lead pipe for the cistern shall be with PVC of sufficient length with necessary fittings, operating chain/lever etc.

6.9 URINAL FLUSHING APPARATUS

The urinal cisterns or flushing tanks shall be high level plastic or vitreous chinaware automatic self acting type conforming to IS : 2326 the capacity of the cistern shall be based on the no. of urinals served at 2.5 litres per urinal at intervals of not less than 10 minutes and not more than 20 minutes.

6.10 WASH BASIN

a) Wash Hand Basin : The basins shall be of white vitreous china of approved pattern. The size of the basin shall be as specified. The basins shall be of approved quality and make and conforming to IS : 2556 part 4.

b) Fittings : Each wash hand basin shall be provided with pillar tap as specified, having a centered tap hole with C.P. protruded nose pillar cock heavy type. This must be included with 32 mm dia C.P. basin waste, C.P. Bottle trap & concealed G.I. waste pipes (Or heavy PVC waster pipe of required length with C.P. brass couplings) as stated in the respective Schedule of items.

c) Fixing : The circular basins shall be supported on counter top and the rectangular basins shall be supported on a pair of C.I. concealed type brackets embedded in wall or fixed in position by means of wooden cleats and screws as required.

d) The waste pipes shall discharge into the floor trap inlet or as specified

6.11 LABORATORY SINKS

a) Sinks : The sink with drain board shall be of best quality stainless steel, make of approved quality & brand . The size of the sink shall be as specified. The sink shall be of approved quality and confirming to IS:771 or IS:2556 Part 5

b) Fixing : The sink shall be supported on M.S. fabricated on C.I. cantilever bracket to match with sink profile. Embedded or fixed into position by means of wooden cleats and screws or embedded in wall with concrete as per site condition. The brackets shall be painted with approved shade and colour to match with the surrounding finish.

c) The G.I. waste pipe shall discharge into floor trap inlet or as specified.

6.12 TOILET REQUISITES

a) Mirrors : The piece glass mirrors shall of approved make glass as specified. The size and shape of the mirror shall be as specified. It shall be mounted on the asbestos sheet and shall be fixed in position by means of C.P. brass dome shaped screws over rubber washers and rawl plug firmly embedded in wall .

The plate glass mirrors of suitable shapes & size as per detailed drawings shall be provided with accessories for round counter type basins.

b) Water connection : water connection to flushing cistern, wash hand basins shall be by means of white PVC connector or C.P. connector with stop cock as specified in the respective items.

c) Shelf : Unless otherwise specified the shelf shall be of porcelain of approved quality & design. The size of the shelf shall be as specified. The brackets shall be fixed to the wall with C.P. brass screw to wooden plug firmly embedded in the wall.

d) Urinal Partition : Unless otherwise specified partition for urinal shall be shape out of 20mm thick x 900 mm white marble. Fixing shall be done by inserting the portion approx 75mm inside wall & grouting the same in cement concrete (1:3:6). All the exposed surfaces & edges shall be properly ground to shape and polished. Joint with wall to be finished with white cement.

e) Towel Rail : The towel rails with bracket of brass C.P. or anodized aluminum as stated in Schedule of Items shall be of approved shape and design. The size of the rail shall be of approved shape and design. The size of rail shall be of approved shape and design. The size of the rail shall be as specified. The brackets shall be fixed by means of C.P. brass screws or Rawl plug firmly embedded in wall.

f) Paper Holder :- The paper holder shall be for white vitreous chinaware of recessed type & the rate shall include chase cutting of walls, setting in cement sand mortar & making good the all round joint with white cement.

6.13 BRASS OR C.P. ON BRASS WATER FITTINGS (AS SPECIFIED IN RESPECTIVE SCHEDULE OF ITEMS)

All fittings shall be of standard Manufacture and shall in all respect comply with the Indian standard specifications. The brass fittings shall be fixed in pipe line in workman like manner . Care must be taken to see that joints between fittings are made leak proof . The fittings and joints shall be tested to a pressure of 7 kg. per 80cm unless otherwise specified. The defective fittings and the joints shall be repaired, redone or replaced at the contractor's expenses.

6.13.1 Bib cock : The bib cock shall be of horizontal inlet & free outlet of specified quality of screw down a pattern of the size as specified. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of threaded spindle which operates it. The handle (Head) shall be of approved design & shape. The cock shall open in anti-clockwise direction. The cock shall be polished bright (For brass) and chrome plated on brass (For C.P.) . Minimum weight shall be 0.40 kg. For 15mm size bib cock.

6.13.2 Stop Cock : The stop cock shall be plain or angular type as per it's place of installation & of specified quality opening anti clockwise & of screw down pattern of the size as specified. Other specifications shall be as per the specification of Bib cock above.

7.0 INSTALLATION OF SANITARY APPLIANCES AND FITTINGS

7.1 SCOPE

The scope under this section shall cover installation of sanitary appliances, fittings and ancillaries.

The following standard specification and codes shall be applicable.

a) SP : 35 (S & T) - Hand book on water supply and drainage

b) IS : 2064 - COP for selection and maintenance of sanitary appliances

7.2 GENERAL REQUIREMENTS

The appliances, accessories and fittings shall be installed as indicated on the drawing and perfectly matching the interior and the tile pattern, heights and properly leveled. The piping and pipe connections shall be done such that minimum length of the piping/pipe connections are exposed.

Sufficient care shall be taken to avoid breakage and damage to the appliances, fittings and the buildings, tiling, interior works etc. carried out by other agencies. Also care shall be taken whole fixing the appliances and fittings to achieve rigidness and to avoid movements of appliances and fittings which can result in damage to the water supply and drainage connections/joints.

The screws shall be fixed to the wall by providing wooden rawl plugs or anchor fasteners in wall depending upon the weight. All exposed screws, nuts and bolts shall be of heavy quality CP brass with CP brass washers.

All brackets shall be finished with two coats of synthetic enameled paints of colour matching the interior/tiles. The water supply and drainage connection to the fittings and assemblies shall be made by means of approved leak proof joints.

All pipe connections and drain connection made to the appliances shall be leak proof and with minimum length of exposed pipes. The WC, urinals and the bath tub drain connection shall be through P or S traps and the traps shall be connected to anti siphon ventilation pipes.

7.2.1 WATER CLOSETS & BIDET

The Indian and Orissa WC shall be set in brickbat concrete 1:2:4. The wall hung European WC shall be supported by CI floor mounted chairs. The joints between WC and flush pipe shall be made with a putty of white lead and linseed oil and caulked well or with an approved rubber joints. The joint between WC and trap shall be made with leak proof 1:1 cement mortar. The foot rests for the Indian WC shall be fixed at proper distance with 1:2 cement mortar with edge finished in while cement.

7.2.2 URINALS

The urinals shall be fixed to wall by CI bracket and two CI wall clips. Cistern shall be fixed to the wall with R.S or C.I brackets. Partitions to be grouted to the wall with screws and M.S clips. The wash basins and sinks shall be fixed with R.S or C.I brackets and clips and securely fixed to the wall. The semicircular channels shall be laid in perfect slope in 20 mm thick 1:2 cement mortar with white cement paste joints.

7.2.3 WASHBASIN

Wall mounted wash basin shall be fixed to the wall using CI brackets. The counter top wash basin shall be mounted on to the counter after cutting the counter to the exact size to achieve tight fixing. The counter shall be fixed to the wall using GI brackets. The cut edges of the platform/counter shall be ground to achieve proper shape and smooth surface.

7.2.4 WASH ROOM ANCILLARIES

The concealed soap tray, toilet paper holder etc. shall be fixed flush with the tile by cutting the wall and set in 1:2 cement mortar surface mounted units shall be screwed to the wall. The towel rod, towel ring, towel rack, shower curtain rod, retractable cloth lines, coat hooks, bottle opener etc. shall be fixed to the wall/door in lines and levels to match the tiling pattern and as indicated on the interior drawings.

7.3 SANITARY FITTINGS & ACCESSORIES

The WC flush assembly shall consist of 32/40 mm flush valve, regulating valve and flushing pipe assembly. The flush valve shall be concealed or exposed type. The bidet water supply assembly shall be single/3 hole and shall consists of hot and cold mixer ascending spray, directing valve pair or stop cock and flexible pipes etc. the waste assembly shall be 32 mm waste with pop-up. The wash basin water supply assembly shall be single/3 hole and shall consists of pillar tap with hot and cold mixer, pair of stop- cock with flexible pipe.

The waste water assembly shall consist of 32 mm waste with pop-up, bottle trap with extension pipe and wall flange etc. The single water supply assembly shall be wall or sink mounted with swan neck spout, hot and cold mixed, pair of angle valve with flexible pipe incase of sink mounted assembly. The waste assembly shall consist of 40 mm waste with pop-up bottle trap with extension pipe and wall flange.

The bath tub water supply assembly shall consists of single wall/bath tub mounted spout with hot and cold mixer, diverter, riser pipe with clamps, 150 mm swivel type shower rose etc. The waste assembly shall consists of 40 mm waste, 40/50 mm P or S trap with cleaning eye, access door etc. The bath and shower water supply assembly shall consists of single wall spout, hot and cold mixer assembly with diverter, riser pipe, 150mm swivel type shower rose etc.

8.0 THERMOPLASTIC PIPES

The thermoplastic pipe shall be of Polyvinyl chloride (PVC),Polypropylene (PP) or Polyethylene (PE) as indicated on the drawing and schedule of materials.

The thermoplastic pipes and fittings shall conform to the following standards and codes.

a) IS : 4984 High Density PE (HDPE) pipes for water supply.
b) IS : 4985 Unplasticised PVC (UPVC) pipes for potable water supply.
c) IS : 10124 Fabricated PVC fittings for portable water supply
d) IS : 5382 Rubber sealing rings or gas mains, water mains and sewers
e) ASTM-D1785 Threaded UPVC pipes
f) DIN : 8076 Fittings with metal inserts
g) DIN : 8077 Polypropylene pipes
h) DIN : 8078 Polypropylene pipe type 3 quantity requirement test
i) DIN : 16962 Joints and fittings for PP pressure pipes
j) ISO : R288 Fittings with threaded metal inserts
k) DVS : 2208 Welding of thermoplastic materials.

8.1 The PVC pipes shall be unplasterised (UPVC) or chrominated (CPVC) suitable for solvent joints conforming to IS : 4985 . The fittings shall be injection moulded. Composite fittings conforming to ISO – R288 having combination of PVC and gunmetal ends shall be provided at connection to equipments valves and outlets PVC pipes with threaded joints wherever required shall conform to ASTM-D-1785.

8.2 The polyethylene pipes shall be of HDPE UV stabilized suitable for electro fusion welding. The connection to equipments, valves and outlets shall be through combination flanged joints having flanges of HDPE and metal.

8.3 The polypropylene pipes shall be of Homopolymer (PP-H) or Randum copolymer (PP-R) conforming to DIN .8077 suitable for electro fusion joints.
The fittings shall conform to DIN 16962 for fusion welding. Fittings for connection to equipments, valves and outlets shall be with composite fittings conforming the ISO R288. The polybutylene (PB) pipes shall be suitable for electro fusion or socket fusion welding.

9.0 THERMOPLASTIC PIPES

The thermoplastic pipe shall be of Polyvinyl chloride (PVC), Polypropylene (PP) or Polyethylene (PE) as indicated on the drawing and schedule of materials. The PVC pipes and fittings shall conform the following standard specification.

a) IS : 13592 Specification for unplastized PVC pipes for SWR discharge system inside buildings including Ventilation and Rain water system
b) IS : 14735 Specification for UPVC pipe fittings for SWR discharge system inside buildings including Ventilation and Rain water system
c) IS : 4984 High Density PE (HDPE) pipes for water supply
d) IS : 4985 Unplasticised PVC (UPVC) pipes for potable water supply
e) IS : 5382 Rubber sealing rings or gas mains, water mains and sewers.

9.1 The PVC pipes and fittings for the drainage system shall be unplasticised SWR quality and conforming to IS:13592 class B for pipe dimensions and wall thickness. The fittings shall be injection moulded and the dimensions shall conform to IS : 14735 .

The fittings shall be suitable for the application and shall be with adequate inspection windows. Pipes smaller than 75 mm required for equipment drain connection shall be of conforming to IS : 4984 and 4985.

10.0 VALVES

10.1 SCOPE

The scope under this section shall cover requirements, details and specification of valves and other control accessories in water circuit.

10.2 STANDARDS

The following standards shall be applicable:

a) IS : 778 Gate, globe and check valves, copper alloy for water supply works purposes.
b) IS : 780 Sluice valves for water works purposes (50 to 300 mm sizes)
c) IS : 1703 Ball valve (horizontal plunges type) including floats for water supply purposes.
d) IS : 3004 Plug cocks for water supply purposes
e) IS : 4928 Check valves, quip closing for centrifugal pump outlets.
f) IS : 9739 Pressure reducing valves for domestic water supply systems
g) IS : 9896 Ball valves, general purposes
h) IS : 779 Watermeter domestic type

The valves for the control of steam shall meet the requirements of IBR and approved by them.

10.3 GENERAL REQUIREMENTS

The valves shall be of reputed make with ISI mark, suitable for the specified duty such as

a) Medium to be handled
b) System pressure
c) System temperature

The material and type of construction shall be as indicated in section 2101 systems and

materials, schedule of materials and shall be suitable for the duty specified.
The valves upto 50 mm shall be screwed type and 65 mm and above flanged type unless otherwise specified. The valves shall be with non rising spindle and the flanges drilled to BS : 10 table E or to match the flanges incorporated in the piping work.

The valves installed in steam fuel oil LPG etc. requiring the approval of local authorities shall be one of the recommended makes of the concerned authority.
The valves shall be rated for a test pressure of minimum 20 kg/sq.cm.

10.4 VALVES FOR VARIOUS SYSTEMS

The valves for various sizes shall be as indicated below:

a. UPTO 50 mm Ball Gun metal Bronze 65mm & above Butterfly Cast Iron SS 316 / SG iron

10.5 STOP VALVES

The stop valves shall be gate or butterfly as indicated in the drawing and schedule of material conforming to IS:778 & IS:780. The stop valves shall be capable of complete stoppage of flow of the medium handled with solid wedge, split wedge or parallel double disc type.
The butterfly valves shall be with circular or lense shaped disc pivoted in the body by two unions. The operating handle shall be provided with locking facility and shall have flow indication.

10.6 CONTROL VALVES

The flow control valves shall be ball type with spherical gate to control the flow the medium. The valves shall be capable of complete stoppage of flow of the medium handle to enable them to use for stop valves.

10.7 CHECK VALVES

The check valves/non return valves shall be unidirectional flow allowing the normal flow in one direction and completely stop the flow in reverse direction. The check valves or reflex valves shall be suitable for horizontal as well as vertical installation and shall be with circular disc hinged at one end.

11.0 PVC/UPVC PIPE ASSEMBLY

The UPVC pipe assembly shall be carried out by means of solvent cement and rubber ring. The pipe assembly and fabrication shall be generally as per the recommendation of the manufacturer. The cur end of the pipe shall made smooth by filling before the carrying out of the assembly. Space provision of minimum 10 mm shall be kept inside the socket for expansion.

UPVC piping with threaded assembly shall generally be as indicated in GI pipe assembly. The pipe shall be supported as per the recommendations of the manufacturer to avoid sagging and stress on the joints. The support interval shall, at any case, not exceed 1500 mm.

11.1 POLYPROPELENE /POLYBUTYLENE PIPING

The PP-R and PB piping shall be through fusion welding as recommended by the manufacturer. The pipe ends are to be smoothened and cleaned thoroughly before making the joint.

The pipes end to be welded shall be heated to the adequate temperature and duration to achieve proper joint. The polyfusion welding duration shall be as per DVS 2207 norms furnished below.

Pipe size (mm)	Heating time (Sec.)	Working time (Sec.)	Cooling time (Sec.).
16	4	3	2
20	5	4	2
25	7	4	2

32	8	6	4
40	12	6	4
Pipe size (mm)	Heating time (Sec.)	Working time (Sec.)	Cooling time (Sec.).
50	18	6	4
63	24	8	6
75	30	8	6
90	40	8	6
110	50	10	8

11.2 CLEANING

The pipe shall be thoroughly cleaned internally and externally during the fabrication, assembling and completion, of the entire piping work using compressed air, clean water etc. Necessary detergents shall be used while cleaning and flushing the piping system and in-line instruments, traps etc. shall be isolated.

All field fabricated piping shall be cleaned at the completion of fabrication. Care shall be taken to see that all burrs, welding icicles and weld spatter are removed by reaming, chipping, filling sandering or ther suitable means. All foreign material such as cement, motor sand, heavy oil lid and loose scale shall be removed from the interior of pipe by thoroughly flushing with water.

To avoid large size foreign material being washed into smaller diameter branch blind from a larger diameter header line, special precautions should be taken to disconnect at branched or to selectively blank them off.

A record shall be kept of cleaning of each line or section of erected piping. Cleaned lines shall be tagged.

Proper temporary drainage for flushing water shall be provided so that no damage is done to permanent facilities.

Valves shall be cleaned when received. All possible precautions shall be taken to prevent contamination and valves shall be inspected immediately prior to installation. If a valve is found to be contaminated in any way, it shall be cleaned as follows:

Removed all foreign particulars by wiping with clean lint less cloth. Wipe interior of valve with clean lint less clothes moistened with clean trichloroethylene

If contamination is excessive in metallic valves, suspends the valve in a degreasing tank with hand wheel uppermost. Direct stream of liquid trichloroethylene into the rim of the valve, though both ends and against all inside surfaces. Flush thoroughly to remove all foreign matter.

12.0 DRAINAGE ANCILLARIES

12.1 SCOPE

The scope under this section shall cover miscellaneous items and ancillary structures for drainage system such as floor trap, floor gratings, manholes, drop connections etc.

12.2 STANDARDS

The following standard specification and codes shall be applicable.

a) IS : 35 (S&T) Handbook on water supply & drainage
b) IS : 5961 Specification for CI gratings for drainage purposes
c) IS : 4111 COP for ancillary structure system
d) IS : 1726 Specification for CI manhole covers and frames
e) IS : 5455 Specification for CI steps for manholes

12.3 FLOOR TRAPS

Floor traps of CI inlet hopper with necessary inlet socket shall be provided wherever indicated or required the joint hopper inlet sockets and waste line shall be lead caulked. The hopper connection with P or S trap shall be with minimum 50 mm seal. The floor trap and inlet hoppers shall be set in 1:2:4 concrete.

12.4 FLOOR GRATINGS

The floor and urinal traps shall be provided with 100 or 150 mm square or round CP or SS grating of minimum thickness of 5 mm with approved sizes. The floor grating in kitchen shall be 150 mm square 20 mm thick cast aluminum supported by 25 x 25 x 6 aluminum angles.

12.5 MANHOLES & INSPECTION CHAMBERS

Manholes and inspection chambers shall be provided as shown on the drawings, additional requirements if any, due to site condition or modification in the design during the progress of work shall be carried out.

The manhole flooring shall be of 1:2:4 concrete with drain channels. The channels shall be semicircular bottom, of dia same as the pipe with side walls of height equal to the radius of the pipe. The channels shall follow the same slope as the mains. The branch channels shall also follow the same slope and construction. A minimum fall of 40 mm shall be given at the junction of branch channels meeting the main channel the fall shall be suitably curved to direct the fall suit the flow in the main channel. The channels and the flow shall be given smooth finish with 1:2 cement plaster.

The manhole walls shall be of brick or rubble masonry with both sides plastered with 1:2 cement plaster and required water tight. Relieving arches shall be provided on the wall to prevent load on the pipe embedded inside the wall.

Inlet and outlet of the mains shall be encased in the wall such that the slope of the

piping is continued. In case of increase in the outlet pipe, the crown of the inlet and outlet pipes are maintained the same and the slope of the channel is increased or maintained at the center line of pipes in case crown level cannot be maintained the same.

Steps shall be provided inside the manhole of depth 750 mm and by grouting two vertical columns of staggered CI rungs of not less than 3 kg. each. The rungs shall be spaced at 400 mm horizontally and 400 mm vertically with the lowest rung not more than 300 mm from the benching and highest 450 mm from the manhole cover. The manhole covers and frames shall be of CI double sealed pattern conforming to IS:1726. The covers shall be best foundry gray metal, tough and close grained and provided with two coats of black bituminasitc paint. The frame shall be embedded in 1:2:4 cement concrete to correct levels and alignment and made water tight.

12.5.1 MANHOLES, GULLY CHAMBERS ETC

a) Size of Manhole : The size specified shall be the internal size of the manhole. The work shall be done strictly as per drawing and specification. The following specifications shall be adopted.

b) Excavation : The manhole shall be excavated true to dimensions and levels shown on he plan or as directed by the Architect/Owner.

c) Brick work: The brick work shall be with bricks having crushing strength 75/sq. cm brick in cement mortar 1:4 . It shall be 250 mm thick or as instructed by the architect/ Employer.

d) All angles shall be rounded 7.5 cm radius and all rendered internal surfaces should be hard impervious finish obtained by using a steel trowel. The external troe joints of the masonry shall be finished smooth.

e.) In wet ground 20mm thick cement plaster of the above specifications shall be done on the outside surface of the walls also this plaster shall be water proofed with addition of 1 kg. of acco proof to 50 kg (1 bag) of cement or with addition to any other equal and approved waterproofing compound. The plastering shall be done up to 30cm above the set soil lines.

f) Channel and Benching : Channels shall be semi-circular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitable rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel on appropriate single suitably rounded off in the direction of flow in the main channel.

The channel and benching shall be done in cement concrete (1:2:4) rising at a slope of 1 in 6 from the edges of channel. The channels at the bottom of the chamber shall be plastered with cement mortar 1:4 (1 cement :4 coarse sand) and steel troweled smooth.

g) R.C.C. Work: R.C.C. work for slabs etc. shall be in cement concrete 1:2:4 with steel reinforcement as per detail drawings.

h) Plain Concrete: If used for fixing manhole covers, shall be of the above specifications.

i) Foot Rests : These shall be of M.S. square rods 22 mm or as specified and shall be galvanized or painted with coal tap these shall be embedded in cement concrete (1:2:4) at least (9) 23 cm. while the brick work is in progress. These shall be fixed 30 cm, apart vertically and staggered laterally and shall not reject more than 11 cm from the wall.

j) Manhole covers and frames: All covers shall be of heavy type. these shall be non - locking or locking type as specified and capable of easy opening and closing . These shall ordinarily be gas and water tight, These shall be soluble water seal type manhole cover and frame. the covers as specified in schedule of Quantities, C.I. Surface box for air valves, sluice valves, peet valves etc. shall be of sufficient dimensions to suit the sizes of these fittings and shall be of heavy pattern when fitted in level to heavy traffic and shall be of standard design or as directed by the Architect/Employer.

k) The frame of manhole cover shall be embedded firmly in the R.C.C. slab or plain concrete as the case may be on the top of the masonry.

l) When the manhole is built on the foot path , this shall be provided with 45cm internal diameter or as specified heavy type C.I. cover, or 56cm internal dia R.C.C. covers as specified. When it is built the metalled width of the road under traffic, it shall be provided with approx 22" (560mm) internal diameter heavy type C.I. cover.

m) Painting : All C. I. / M.S. fittings like Manhole covers & frames, gratings, footrests etc, shall be painted with two or more coats of Bitumastic paint & it's rate shall be included in the rate of the Manholes, Gully chambers etc.

12.5.2 TYPES OF MANHOLES

Manhole up to 0.75 Meter Depth: This shall be 0.9M x 0.8 M size (Internal dimension) unless otherwise shown in drawings instructed per site conditions.

a) Thickenss of brick wall-250mm
b) Cement brick work - (1:4)
c) Plaster : Plaster on inside surface of walls, bottom & part of outside surface of walls and on RCC cover slabs shall be done as per drawings and directions.
d) Bed concrete (1:4:8)-150 mm thick with stone chips.
e) Brick flat soling - 75mm thick.

Depth of Manhole above 0.75 M up to 1.5 M : This shall be of 1.2 M x 0.9 M (internal) size unless otherwise shown in drawings or instructed as per site conditions.

Details same as that in item No 28.1 above.

Depth of Manhole above 1.5 M : This shall be of 1.2 M x 0.9 M (Internal) size or as specified.

Thickness of brick wall

i) 250 mm up to 1.5 M from finished G.L.
ii) 375 mm below 1.5 M from finished G.L.

Cement brick work plastering and Brick Flat soling same as in earlier.
Thickness of bed concrete (1:4:8)- 225 mm with stone chips.

12.5.3 Prior approval of Sample Materials /Works : Samples and all materials & works shall be approved by the Architects/Employer before the contractor undertakes any major procurement of materials or proceeds with the works concerned. The quantum of materials/works for approval of samples shall be decided by the Architect/Employer & no extra payment shall be made to the contractor for sample materials procurement/or works & replacement of materials altering or redoing of works as required and instructed by the Architects/Employer.

The typical approved sample material for each work shall be kept in the office of the Employer/Architects at site until the satisfactory completion of the works. The materials supplied and installed at site shall be of the same quality & size as of the approved samples, otherwise they shall be rejected.

The decision of the Owner/Architects or their authorized representatives of whether a materials compares well with the approved sample shall be final and binding on contractor. The same principal shall be applicable to sample work approved & further works done at site.

12.5.4 Cleaning & disinfections of the supply system, water storage tanks and down take distribution pipes : All water mains , communication pipes, service and distribution pipes used for water for domestic purpose should be thoroughly and efficiently disinfected before being taken into use and allows after every major repair. The method and disinfections shall be subject to the approval or the Owner/Architects.

The water storage tanks (underground and Overhead) & pipes shall first be filled with water & thoroughly flushed out. The storage tanks shall ten be filled with water again and disinfecting chemical containing chlorine added gradually while the tanks are being filled, to ensure thorough mixing, sufficient chemical shall be used to five water a dose of 50 parts of chlorine to one million parts of water. If power to 1000 Liter of water . The power shall be mixed with water to a creamy consistency before being added to the water in the storage tank. If proprietary brand of chemical is used, the proportions shall be as specified by the markers, When the storage tank is full, the supply shall be topped and all the taps on the distribution pipes opened successively , working progressively away from the storage tank. Each tap shall be closed when the water discharge begins to smell of chlorine. The storage tank shall then be topped up with water from the supply pipe and with more disinfecting chemical in the recommended proportions. The storage tank & pipes shall then remain charged at least for three hours. Finally, the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

12.6 GULLY PIT :

To be the standard size 1.06 m x 0.63 m and to be built in cement mortar 1:3 or 3:1 as specified in strict accordance with drawings. The internal sides and floor are to be finished with 12mm cement plaster to be fitted with a 150 mm C.I. overflow pipe with hinged cover and handle 0.90x 45 C.I. Gully grid of the standard weight 15 cm syphone. The gully grid and frame are to be of 166 kg.

12.7 S.W. GULLY TRAP :

S.W. Gully trap of specified sizes and quality shall be fixed 15 cm thick cement concrete 1:3:6 bedding and the gully outlet to the branch drain shall be jointed similar to joining of S.W. pipes. A brick masonry chamber 30cm x 30 cm internal shall be constructed in half brick masonry with (1:6) cement mortar and the space between the trap and the wall filled up with cement (1:6) cement concrete (1:4:8) and the upper portion of the chamber finished internally with (1:3) cement mortar and finished with neat cement. The corners and bottom with neat cement. The corner and bottom of the chamber shall be rounded off so as to slope towards the addition the chamber shall have a C.I. grating with frame 30cm x 30cm (inside) with machined rating faces , fixed on the top of the brick with cement concrete 1:2:4 and rendered smooth. The weight of grating shall not be less than 4.53 kgs & that at the frame 2.72 kgs.

12.8 CAST IRON MANHOLE COVERS AND FRAMES :

Unless otherwise mentioned the covers and frames shall be conform to I.S. specifications and obtained from the approved manufacturer's and shall be of following grades and type generally manufactured by M/s D.N. Singh & Co., M/s R.M. Chatterjee & Foundry of M/s Thakuradas surekha or equivalent brand. Heavy duty covers etc., under heavy vehicular traffic condition & cable of bearing while loads up to 11.25 tones are to be used medium duty under light type wheel traffic load. Light duty for domestic premises use or other places where they are not subjected of wheel traffic loads.

Covers and frames shall be cleanly cast, double water soil type and they shall be free from air sand holes, cold shuts and wrapping which are likely to impair the utility of the casting. All casting shall be free from voids. The cover shall be gas tight and water tight with proper seal arrangement, but can be easily opened and it shall be fitted in the frame in workmanship like manner . The cover used for sewer line should be sewer ingrained on top of casting. Similarly for storm line it shall be marked storm. Size and dimensions are given below with weight. Covers shall have raised chequered design to provide an adequate non slip grip. The covers and

frame shall be coated with a material having tar base or with black bituminous composition.

Grade	Type	Overhead size in cm	Clear opening in cm	Weight of cover in Kg	Weight of frame in Kg	Test load in Ton
HD	Double Triangular	76x76	50 56	118 140	111 115	35 35
HD	Circular	76 dia	50 dia	118	111	35
		81 dia	50 dia	140	115	35
HD	Circular	81 dia	50 dia	58	58	5
		76 dia	56 dia	64	64	5
HD	Rectangular	84x68.5	61x45.5	80	64	5
HD	Rectangular	75x56	45.5x61	29	23	
HD	Circular	76 dia	45.5 dia	29	23	

The coating shall be smooth and tenacious. It shall be not flow when exposed to a temperature of 60 degree centigrade and shall not be so brittle as to chip off at temperature of 0 degree centigrade. The frame of manhole cover shall be firmly embedded to concrete alignment and levels in R.C.C. slab or plain concrete as the case may be.

12.9 DROP CONNECTIONS

Drop connection of required size and length shall be provided for the main sewer in step grounds and inside manholes when the difference in invert level of the pipes exceeds 450 mm. The drop connections from gully traps to manholes shall be inside manholes using HCI special outdoor bend at the top and heel rest bend at the bottom assembled with 25 mm deep lead caulked joints. The pipes shall be adequately supported by holder bat clamps.

The drop connection from branch to main shall be outside the manhole with glazed stoneware pipe with tee at the top and bend at the bottom. The pipe and fittings shall be embedded in 1:2:4 cement concrete of minimum 150 mm all around the pipe and extending the tee and the concrete upto the surface with 300 x 300 mm hinged CI cover and frame.

13.0 CIVIL & STRUCTURAL WORK

13.1 SCOPE

The scope under this section covers, civil structural and allied work such as

Earth work and trenches
Concrete work
Masonry walls and plastering
Chasing and opening
structures Structural steel
work Protective coating and
painting

13.2 GENERAL REQUIREMENTS

All civil and structural work connected to the work specified shall be the responsibility of the contractor. Necessary care shall be taken to avoid damages of existing underground services such as water and drain lines, electrical and telecommunication line etc. and existing surface drainage system, such as channels, culverts bridges etc. Necessary diversion and supports to the existing services and surface drain etc. and retain them in their original conditions, care shall be taken to avoid damages to the building and other structures and least interference to pedestrian vehicular traffic.

Proper safety precautions and provision shall be made to avoid accidents and injuries to the workmen employed and other agencies at site. Proper lighting, fencing, road barriers and diversion of traffic, temporary drains, bridging platform on excavation trenches etc. shall be provided.

Care shall be taken to avoid obstruction to the traffic by occupying and stacking the material and excavated soil on the road. The civil contractor shall be suitable for variation of ± 300 mm in the existing ground and finished ground level. The contractor shall assertion the soil bearing capacity and the maximum subsoil water level before submitting the offer. In the absence of the above data the offers shall be based on soil basing capacity of 15 MT/sq.m and water table of 1000 mm. On award of the work the contractor shall carried out necessary test ascertain the above details or obtain the same from the site incharge before taking up the work. Necessary modification required in the design and the construction shall be intimated to the site incharge along with the financial implication before carrying out the work.

13.3 EARTH WORK

The earth work shall include the excavation, back filling and dispose of surplus of soil, filling up and raising the surface level of low areas etc. required for the water supply and

sanitation.

Excavation shall be carried out in open cutting and shall include in soft soil or hard murrum and rocks depending upon the strata of the ground. The excavation shall be taken up in the section after getting the approval of the Consultants/Owner to suit the progress of work at site after taking all precautionary measures. The Consultants shall decide the classification of soil and rocks.

The trenches shall done to widths, depths, lines and levels as shown on the drawing or instructed at site. The bottom and sides shall be trimmed to required levels and profiles etc. watered and thoroughly

The excavation in rocks shall be carried out by chiseling. Where blasting has to be resorted the same shall be carried out after taking all precautionary measures. Permission from all concerned public authorities, paying royalties and other levies, special insurance for the blasting hazards etc. the work shall be taken up at the contractor's entire risk cost and responsibility.

Necessary shoring shall be provided for the side walls for excavation/trenches in soft soil to retain the soil. Similar strutting shall be provided for buildings and structures, the stability of which is liable to be endangered due to proximity of the excavation being carried out/already carried out.

Water accumulation in excavation shall be bailed or pumped out without causing injury to public, public health or structures end properties. Care shall be taken to avoid flow of sand below subsoil water level endangering building and other structures. Any settlements occurring to road, structures and other areas shall be rectified.

The night soil, filth and other debris shall be taken out of the excavations and carted away. Back filling to be done after laying and testing for pressure, slope and water tightness of pipes, manholes etc. backfilling shall be done using good quality soft and hard murrum in layers not exceeding 300 mm and each layer watered and adequately compacted. Care shall be to avoid damages to pipes etc. the surface of the filing shall be finished to lines and levels indicated.

Surplus soil shall be used for filling low laying areas or carted away. Additional soil required for back filling shall be of good quality soft or hard murrum and shall be supplied by the contractor. The width of trench shall not exceed 300 to 350 mm beyond the outer surface of the pipes and the excavation for the manhole junction chambers etc. shall not exceed 300 mm all sides for the edge of the foundation. The depth of excavation shall be upto the invert levels of pipes and other items. Excavation beyond required shall be filled up with cement, concrete 50 m at no extra cost.

13.4 CONCRETE WORKS

The concrete work shall confirm to IS : 456 for normal structures and 3370 for water

retaining structures. The and the mix shall be based on the strength and proportion indicated on the drawing and specification but not less than M20 for normal structures and M25 per water retaining structures.

The cement shall be ordinary Portland cement conforming to IS : 269 and of the best normal setting quality. The sand fine aggregated shall conform to IS : 383 and shall be natural sand crushing gravel sand or crushed stone sand shall be clean sharp angular grit type. Use of sea sand prohibited.

The coarse aggregate shall be hard, clean and washed and shall be stacked according to the gradation after proper sleeve analysis. The water used for the concrete work shall be clean, free from deleterious matters and shall be potable quality.

All batching shall be volume and mixing shall be done in mixing machine till uniform distribution of mix and uniform colour consistency is achieved and for a duration of not less than 2 minutes. The mixture shall be filled in iron pans and immediately poured into the work spot and avoid segregation of aggregates.

Concrete shall be compacted by means of suitable vibrating equipment and the concreting shall be continuous without interruption. Concreting over already set concrete shall be carried out only after the surface of the set concrete is roughened, set clean, moistures and treated with cement slurry.
The concrete shall be kept wet for a minimum of 15 days using gunny bags kept consistently wet by pouring water. The surface shall be plastered and given smooth finish and made water proof.

The concrete shall be cast only after completing properly designed from work with necessary supports to withstand the weight of concrete and compacting. The form work shall be accurately fitted and water tight. The surface of form work in contact with the concrete shall be plain, smooth and treated with form emulsion. The form work shall be removed as per IS : 456 and without shock or vibration.

The minimum thickness of the RCC structures shall be as shown below

Footings for brick wall 150 mm
Lean concrete below water retaining slabs 150 mm
Lean concrete below other structures 100 mm
Water retaining structures 200 mm
Minimum depth of foundation 500 mm

Water bars of minimum 150 mm wide shall be provided at the construction joints of

water holding structures. The water bars shall be of 20 guage GI sheet. Also pressure release valves, if required, shall be provided for water storage tanks to avoid upliftment.

Water storage tanks shall be totally closed with roof slab with adequate manholes unless otherwise specified. Rung ladders shall be provided for storage tank having depth more than 1500 mm. All concrete surfaces shall be plastered as indicated under plastering.

13.5 BRICK MASONARY

The bricks shall be table moulded, hard, sound and well burned with sharp edges, uniform size and shape and shall be free from cracks, stone floats, module of lime or their defects. The bricks shall have a minimum compressive strength of 150 Kg/sq.cm and the weight shall not increase beyond 20% when immerced and taken out of water for 24 hours.

Bricks soaked in water till bubbing disappears shall be used for masonry work and shall be raised uniformly all around and accurately plumb or as shown on drawing. The masonry shall not be raised more than 10 courses in a day and no part shall be raised more than 1000 mm above another at any time.

The joints in brick work shall in 1:4 cement mortar not more than 10 mm thick with bricks properly bedded and joints completely filled to the full depth. The surface of the brick work shall be cleaned down and watered properly before the mortar sets.
The brick work shall be watered thrice a day for a minimum of 10 days. No broken brick ware to be used except as closures.
All brick masonry walls shall be 230 mm thick and shall be plastered on both surface as specified in plastering.

13.6 PLASTERING

The plastering shall be in cement mortar of 1:4 and shall proceed from top to bottom in one operation. The masonry surface shall be thoroughly cleaned, joints raked out to not less than 12 mm, washed and kept wet for 24 hours before plastering. The surface shall be rubbed with mortar to cover all irregularities and scored to provide key. The cement plaster of 15 to 20 mm shall be applied over the surface when the filling coat is still raw. The mortar which falls on the ground shall not be reused.
Plastering on the following surfaces shall be carried out after mixing adequate quantity of water proofing compound.

All exposed surfaces
All underground surfaces
All water holding surfaces

13.7 CHASING & OPENINGS

The chasing and opening in masonry and concrete work shall be carried out carefully and using proper tools. The openings shall be minimum to accommodate the pipes or fittings and no damage is caused to the structures or works carried out by others. Care shall be taken to avoid chasing walls on both side at same levels and routing. The opening and chasing shall be closed after laying and fixing the pipe using cement mortar and GI wire mesh.

13.8 STRUCTURAL STEEL WORK

The structural steel work for support of equipments, pipes and tanks shall be included in the scope. The steel and the fabrication shall conform to the following.

a)	IS : 800	COP for use of structural steel in general building construction.
b)	IS : 805	COP for use of steel in gravity water tanks
c)	IS : 401	COP for steel tubular scaffolding
d)	IS : 7205	Safety code for erection of structural steel works.

The base frame for the equipments shall be fabricated out of ISMC 75 or as shown on the drawing. The structural work shall be in MS with sections as shown on the drawing or subject to the pressure and load of the items supported. All structural steel work shall be in welded construction using 3 mm welding rod of reputed make.

The structural supports for pipes shall be as shown unless otherwise specified or shown on the drawing. GI pipes upto 65 mm running at ceiling Channels/angle irons members suspended from ceiling by means of 10 m rod or 40 x 3 mm strips CI pipes running at ceiling Channels and sections grouted on side walls Pipe risers Slotted angle fixed to the wall at every 1000 mm by means of bolts embedded in the wall.

The pipes shall be clamped to the structural supports by means of U clamps fabricated out of 40 x 3 mm GI strip or GI U bolts.

13.9 PROTECTIVE COATING & PAINTING

Structural steel work and the pipes shall be provided with anti corrosive treatment and two coats of synthetic enameled paints. All mild steel work shall be given two coats of paint.

INTERNAL ELECTRIFICATION WORKS

INTERNAL ELECTRIFICATION WORKS

CONTENTS

1.0 GUIDE LINES

1.1 SCOPE

The scope of this section covers guidelines for the contractor on the specification and schedule of material and the general requirements.

1.2 SCOPE OF CONTRACT

The scope of work under this contract covers equipment, material, accessories and labour required for the specified works and to carry out the erection as specified and shown on the drawing and schedule of material.

Safety, good workmanship and quality are the prime requisites of the work covered under this contract. All the equipments, material and the work carried out shall meet the relevant codes, specification and the intents of specifications and the proper functioning of the systems and installation and shall be in correct lines, levels etc.

1.3 MATERIAL

The equipments and material shall meet the specifications and requirements indicated in the technical specifications covered under specific section and the relevant equipment data. The makes of material shall be one of the recommended makes covered under Section 104 makes of material.

1.4 SPECIFICATION

The technical specification attached herewith gives general guidelines and minimum standards for equipments material and workmanship. However it is the responsibility of the contractor to meet the statutory provision and local codes.

1.5 SCHEDULE OF WORK

The schedule of work indicates the scope and quantity of the work estimated at the time of preparation of this tender. The quantity indicated are based on rough estimate on the basis of the drawings and subject to variation due to site condition. Also additional requirements may arise during the installation and deletion or replacement of items. Hence there shall be variation in quantities indicated and the unit rates quoted shall remain firm during the contract period.

1.6 STANDARDS & REGULATIONS

Each section indicates the Indian Standard Specification to be followed. It is the responsibility of the contractor to meet the statutory regulation local codes and other relevant standards and specifications connected to the work being carried out.

1.7 INSPECTION & TESTING

1.8 The Consultants/Clients have the right to inspect the plants, equipments and material at manufacturer's work or at site at any stage and reject the material that is substandard or does not meet the requirements of the specification and codes.

The contractor shall provide at his cost at site and elsewhere instruments and appliances for testing and equipments and installation at various stages of manufacturing/installation. These instruments shall be got tested and calibrated for their accuracy and performance from the approved institutions.

The inspection and testing carried out by the Consultants/Clients/Third party does not relieve the contractor of their responsibility of carrying out routine inspection during each stage of procurement, manufacture and installation and also meeting the intents and requirements of the specification and statutory requirements.

All equipments and the installation to be tested in the presence of the Consultants/Clients after carrying out necessary rectification, adjustments and balancing. Four sets of test readings should conform to the specification, equipment data, standards and codes.

1.9 TRAINING

The operating staff of the clients shall be trained free of cost for the operation, maintenance overhauling etc. of the equipments and installation.

1.10 STATUTORY INSPECTION

The contractor shall be fully responsible for meeting all the statutory obligations and local inspectorates pertaining to the works carried out by them. The contractor should prepare all working drawings and obtain approval of competent authorities and also have the equipment and installation inspected and got approved.

All official fees will be paid by the clients directly against demand in writing from the appropriate authorities and all other expenses for submission and approval of the various relevant statutory bodies shall be embodied in the tender prices. You shall also do the necessary liaison work with the power supply company on client's behalf.

1.11 DEVIATIONS

Should the tenderer wish to deviate from the provision of specification and drawings, the same shall be indicated separately along with supporting drawing and specifications to decide the merits of such deviation. In the absence of any deviation it is deemed that the tenderer is fully satisfied with the intents of specification and drawings and their compliance with the statutory provisions and codes.

However, the offer shall be strictly on the basis of tender specification and schedule of material. The offer for the deviated items shall be furnished separately.

1.12 REFERENCE DRAWINGS

The drawings issued with the tender and shown in relevant section are basic diagrammatic drawings and is part of the tender documents. Contractor shall preserve one set of this drawing in good condition incorporating all modifications carried out from time to time during the erection period at the site and shall return them to the Consultants/Clients after completion of the work.

1.13 WORKING DRAWINGS

Contractor shall prepare and get approved shop drawings/fabrication drawings prior to execution of work for the following:

a) Layout of substation indicating the details of poles, switches, accessories etc.
b) GA, schematic and control drawings for switchgear panels, transformer etc.

On completion of work the contractor shall prepare 'AS BUILT' drawings and one set in CD in Autocad format and two sets hard copy shall be submitted.

1.14 MEASUREMENTS AND PAYMENTS

The mode of measurement and payment shall be strictly indicated under relevant Section measurements and payments. This indicates the mode of measurement, items to be included and items excluded etc. in a board basis. However, it is the responsibility of the contractor to meet the intents of the specification and total installation on the works contract/turnkey basis.

1.15 HANDING OVER

The installation shall be handed over after a satisfactory testing along with the following documentation.

a) Two sets of prints of the as installed drawings along with CD
b) Two sets of test reading and certificate of local authorities.
c) Two sets of detailed equipment data and operation and maintenance manuals.
d) List of recommended spares.
e) Performance guarantee in the prescribed form.

The final acceptance shall be effective only after the submission of the above documents.

Final payment will be released only after the handing over and submission of documentation.

1.16 PERFORMANCE GUARANTEE

All equipment and the entire installation shall be guaranteed to yield the specified ratings and design conditions plus/minus 3% tolerance. Any equipment found short of the specified ratings by readings shall be rejected.

2.0 DIVISION OF WORK

2.1 SCOPE

Scope under this section the division of work between the contractor and others on a broad basis, both supply of material and installation. The details of material to be included in the supply items as well as installation, testing and commissioning of the system are covered under respective section and measurements and payments.

The scope of work of the contractor for installation of equipments and material supplied by the clients covers:

a) Taking delivery of material, storage and safe custody till handing over.
b) Transportation to the site of erection.
c) Supply of all fixing material, supports and accessories.
d) Supply of consumables for testing and commissioning.
e) Maintaining register of material received and utilized.
f) Hand over excess material.

Clients hold the option to supply some of the major material and debit it at the quoted supply rate.

3.0 MEASUREMENT & PAYMENT

3.1 SCOPE

The scope under this section covers the mode of measurements and payments for all items.

3.2 DIVISION OF WORK

The measurement and payments of items shall be based on the stage of completion of the work and shall be as indicated elsewhere in the tender.

3.3 REQUIREMENTS

The general requirements for the above items shall be as shown below:

A) SUPPLY OF ITEMS

This shall include supply material and accessories required for the completion of the entire installation specified under various headings.

B) INSTALLATION, TESTING & COMMISSIONING

This shall include supply of all supporting material and accessories, equipments, tools and consumables for fixing, testing and commissioning and labour.

3.4 MODE OF MEASUREMENT

The mode of measurement and the basis material to be included are as shown below. However, the item required for the proper installation other than that clearly indicated in the items excluded to achieve proper installation finish and functioning of the whole system shall be the responsibility of the contractor.

Cutting and chasing of brick walls, rectifying, levelling etc., wherever required shall be included in the scope of work. No chasing or cutting shall be done on RCC work. The fixing of supports and hangers to RCC work shall be done using anchor bolts/fasteners of adequate capacities, which are included in the scope of work. Cutting of brick shall be done with wheel cutter. The final finish of chased area will be carried out by civil agencies.

SI NO	ITEM	ITEM INCLUDED	ITEM EXCLUDED
1	PANELS & DBS Each MV panel shall be measured as one unit	Supply of panel fixing accessories	Trench
2	DISTRIBUTION BOARDS		
2.1	Each DB shall be measured as one unit and shall be classified on the basis of no. of circuits	Incoming and outgoing feeders busbars and interconnection, protecting and indicating meters and instruments fixing accessories	Nil
2.2	SWITCHGEAR		
	Each switchgear such as starter,switchfuse units etc. shall be measured as one uni	Feeders,enclosures fixing frames etc.	Nil
3	CABLING		
3.1	CABLE		
	The cables shall be measured on the basis, unit length between the termination lugs	Cable,clamps,cable markers, sand bricks etc.	Cable tray, end termination of built up trench
3.2	END TERMINATION		
	Each cable end termination shall be measured as one unit and shall be classified based on the type and size of cable	Cable gland, lugs nuts and bolts earthing of gland and armour	Nil
3.3	CABLE TRAYS		
	The cable trays shall be measured on the basis of unit length and shall be classified on the basis of type and size of tray	Trays, bends, tees, coupler etc.	Supports

3.4	PIPES		
	Pipes shall be measured on unit length basis	Pipe, fittings, excavation, back filling	Nil
4	EARTHING		
4.1	EARTHING STATION		
	Each earthing station shall be measured as one unit and shall be classified on the basis of type and material of earth electrode	Earth electrode,testing link, excavation soil treatment, watering pipe,chamber and cover	Nil
4.2	AIR TERMINATION		
	Each air termination shall be measured as one unit	Air termination,fixing materials & accessories	Nil
4.3	EARTH CONDUCTOR		
	The earth conductor shall be measured as on the basis of unit length and shall be	Earth conductor, excavation for external conductor,PVC sleeves for lightning conductor down	Nil
	classified on the basis of material and size of conductor	take, clamps, screws accessories	
5	WIRING INSTALLATION		
5.1	CONDUIT WIRING		
	Each circuit point shall be measured on the basis of unit length	Conduit and accessories, wires, clamps termination etc. from DB to the first electrical outlet/fitting, including wiring to the switches, if any	Control switches with boxes
5.2	Each secondary point looping from circuit point/outlet/ switch/fitting shall be measured as one unit	Conduit and accessories wires, clamps, outlet box	Control switches socket etc.
5.3	Each control switch outlet shall be measured as one unit. Multiple control switch outlet shall be considered as that many no. of switch outlets	Control switch and box internal wiring for multiple outlets	Conduit wiring
5.4	Each fan regulator shall be measured as one unit. Multiple regulator outlet shall be considered as that many no. of regulator outlet	Solid state regulator control switch, and box. Internal wiring for multiple outlet	Conduit wiring

5.5	Each socket outlet including combined socket outlet shall be measured as one unit. Multiple socket outlet shall be measured as many no. of socket outlets.	Socket outlet, control switch and box. Internal wiring for multiple outlets and and plug tops for metal clad sockets	Plug tops for 6/16A sockets
5.6	Each light fitting shall be measured as one unit and shall be classified based on the type of fittings.	Fixtures with accessories, fixing material and accessories	Fixture with lamps& control gear, if supplied by clients
5.7	Each ceiling fan shall be measured as one unit and shall be classified on the basis of size of the fan	Ceiling fan, down rod hanging hook	Regulator & switch

5.8	Each propellar fan shall be measured as one unit and shall be classified on the basis of the size and capacity.	Propellar fan, fixing frame, gravity louvers bird screen	Nil
6	LOW VOLTAGE WIRING		
	TELEPHONE		
6.1	Each tag block shall be measured as one unit and shall be classified on the basis of no. of pair of terminals	Tag block, enclosure, fixing accessories	Nil
6.2	The telephone cable shall be	Cable, fixing accessories,	Nil
	measured on the basis of unit length and shall be classified on type and no. of pairs	marker excavation, back filling	
6.3	Wiring of each telephone outlet from the tag block, to individual outlet shall be measured on the basis of unit length	Conduit, wires	Outlet&box
6.4	Each telephone outlet shall be measured as one unit	Outlet with box	Nil
7	FIREALARM/CCTV/PUBLIC ADDRESS		
7.1	Wiring to CCTV, speakers, detectors/hooters shall be measured on the basis of unit length	Conduit, accessories wires, boxes etc.	Devices
7.2	Fire alarm CCTV/Music systems units such as panel,hooter, break glass splitter, speaker etc. shall be measured individually	Splitter,speaker, panel,detector, BG hooter,fixing accessories ,JB etc.	Wiring

3.5 PAYMENTS

The payment shall be made on the basis of quantities measured and the unit rates accepted. The payments shall be made according to the stages/terms indicated in 1201 tender details. Surplus material after completion of the installation shall be taken back by the contractor. In case the owner intents to take over these material, payments shall be made to the contractor at the supply rates/mutually agreed upon.

4.0 SUBSTATION ANCILLARIES

4.1 SCOPE

The scope under this section shall cover the general specification and details for the substation ancillaries such as:

a) Air break isolators
b) Current and potential transformers
c) Lightning arrestors
d) Auxiliary power supply
e) Central control console
f) Pole structure

4.2 STANDARD SPECIFICATION

The standard specification shall be applicable:

a) IS : 1818/1972	Alternative current isolators (disconnectors and earthing switches)
b) IS : 2099/1973	Bushings for alternating voltages above 1000 volts
c) IS : 2165 (PT-3)/1973	Insulation co-ordination PT-3 for equipment having highest voltage for equipment of about 1 KV and less than 100 KV (1st Rev.)
d) IS : 2486 (PT-1)/1971	Specification for insulator fittings overhead power lines with nominal voltage greater than 1000 volts PT general requirement and tests.
e) IS : 2544/1973	Porcelain post insulators for systems with nominal voltages greater than 1000V (1st Rev.)
f) IS : 2705 (PT-1)/1974	Current transformers Part-1 general requirements
g) IS : 2705 (PT-2)/1964	Current transformer Part-2 measuring current transformers
h) IS : 2705 (PT-3)/1964	Current transformer Part-3 protective current transformers
i) IS : 2705 (PT-4)/1968	Current transformer part-4 protective current transformers
j) IS : 3070 (PT-1)/1974	Lightning arrestors for alternating current system part-1 non linear resistor type lightning arrestor
k) IS : 3070 (PT-2)/1966	Lightning arrestors for alternating current system part-2 expulsion type lightning arrestors
l) IS : 3156 (PT-1,2,3)	Voltage transformers Part-1 general requirements, measuring voltage transformer part-2 protective voltage transformer part-3
m) IS : 5792	Drop out fuses
n) IS : 1651	Stationary cells and batteries lead acid type with tubular positive plate
o) IS : 1652	Stationary cells and batteries lead acid type with planted positive plate
p) IS : 6304	Stationary cells and batteries lead acid type with pasted plates

4.3 AIR BREAKER ISOLATORS

The air break isolators/disconnecting switches shall have the following features: a) Single throw double break isolators with or without earthing blade

b) The contacts should be electrical grade copper pressure relieving type. The female fixed contacts shall be high pressure self aligning. The male moving contacts shall be either flat or tubular the contact pressure should not be less than 0.25 kg per amp.

c) Terminal pads shall be copper flat. Terminal connectors should be suitable for receiving ACSR conductor's busbars of adequate size.

d) The current rating of switches shall be based on a temperature rise of 30 deg. C above ambient of 40 deg.C. The one second short circuit rating of the isolator shall be not less than the RMS current of maximum half cycle short circuit current.

e) The isolator shall be provided with make before and break after type copper arching horns of the following requirements to break the magnetic current of transformer

Voltage	Copper rod SWG	Horn gap mm
11 KV	2	200
22 KV	2	250
33 KV	1	330
66 KV	0	510
110 KV	2/0	750

f) The operating control base for all the manual operator isolators are of robust construction. Locking arrangement shall be provided for both "On" and "Off" position. Safety stops are provided on the base to prevent over travel.

g) Auxiliary switches with pairs of contacts of both open and close position and for remote control indication, interlocks etc. should be provided and should be housed in weather proof box designed to operate on standard DC voltage. Mechanical interlocks should be housed in weather proof box.

4.3.1 Isolators should be mounted on the structure with necessary ground clearances as shown in the drawings. All metallic parts not carrying the current shall be connected to earth grid as shown in the drawings. All interlocking feature and isolator position indicator should be connected to relay control panel using suitable size and number of cores control cables.

4.4 TESTING AND COMMISSIONING

a) General inspection of isolators

b) Insulation test of terminal points with respect to earth using 2500 volts meggar.

c) Checking of position of isolator on relay control panel.

d) Checking of interlock i.e. operation isolator should be possible only when circuit breaker in position is 'Off' or incase switch On/Off of isolator circuit breaker should be in 'Off' position or circuit

breaker can be switch on only when isolator in 'On' position.

4.5 CURRENT TRANSFORMERS

Current transformer should be wound type separately mounted HV current transformer should be of live tank design which is mounted on the bushing with fine design aluminium clamps with adequate mechanical strength avoiding any damages.

Rated standard : IS : 2705, BS : 3938

CT assembly will include :

a) HV line terminal
b) Oil expansion chamber
c) Oil level indicator
d) Oil fitting plug
e) Porcelain insulator
f) Tank with cover
g) Lifting lugs
h) Secondary terminal box with HV neutral terminal
I) Oil drain plug
j) Rating and diagram plate
k) Earthing terminal
l) Abnormal pressure relief valve

CTS should be mounted separately with ground clearance as shown in drawing.

4.6 TESTING AND COMMISSIONING

a) General inspection of CTS
b) Marshalling box kiosks
c) Insulation test of the terminal points using 2500 KV meggar.
d) Continuity test of conductors used for remote indication of metering and protection sockets in relays control panel.

Short time rating of CT should be 18 KA for one second.
The epoxy cast CT should undergo PD test essential and other test as per IS specification.

4.7 POTENTIAL TRANSFORMERS

The PT shall have the following salient features :

a) Reference standard : IS : 3156, BS : 3941
b) Rated voltage : System voltage
c) Basic insulation level : 140 KV
d) Primary voltage : system voltage

e) Secondary voltage : 110/3 4.7.1PT assembly should include:

a) N2 filling valve with cap
b) primary terminals
c) Line tank
d) Oil level indicator
e) Porcelain insulator
f) Access for secondary terminals
g) Cable gland
h) Lifting lug with 30mm hole I) Oil filling plug and drain plug
j) Bottom housing
k) Rating and diagram plate
l) Earthing terminals

Other enclosure etc. should be as per manufactures standard design. PT should be mounted separately with ground clearance as shown in the drawing.

4.8 TESTING AND COMMISSIONING

a) General inspection of potential transformer and marshalling box kiosks.
b) Insulation test of terminal points using 2500 KV meggar.
c) Continuity test of conductor used for remote indication of metering and protection circuits in relay control panel.

4.9 LIGHTNING ARRESTORS

Substation has to be shielded against direct lightning storkes by provision of earth wires as shown in the drawing on the same substation. Earth wires should be suitably placed so as to provide coverage to the entire substation equipment.

Besides direct strokes, the substation equipment has to be protected against travelling waves due to lightning strokes entering the substation. Lightning arrestors should be discharge resistance and station class type heavy duty with insulating base.

Lightning arrestor should be mounted separately with ground clearances as shown in the drawings.

Lightning arrestor should be connecting to independent earth pit.

5.0 TRANSFORMER

5.1 SCOPE

Scope of these specifications covers the manufacturer, testing, supply, installation and commissioning of transformers.

5.2 GENERAL REQUIREMENTS

System of supply shall be 11/22/33 KV, 3 phase, 50 cycles, solidly earthed system as indicated in equipment data.

5.3 RATING

Transformers shall be rated as per the design consideration and as IS:2026.

5.4 NO LOAD VOLTAGE

No load voltage shall be 11000/22000/33000 Volts on H.V. Side and 433 Volts on M.V. Side.

5.5 CONNECTIONS

Connections shall be Delta on H.V. side and star on MV side with Neutral terminal brought out for solid earthing.

5.6 VECTOR GROUPS

Vector groups shall correspond to the Vector Symbol Dyn-11

5.7 IMPEDENCE

The transformers shall be so designed and manufactured to have matched impedance for a parallel operation. Impedance shall be 5% and variation in impedance of the ultimate finished product shall be within +/-5% of the nominal impedance value.

5.8 TYPE

Transformer shall be suitable for indoor or outdoor and oil cooled or Resin cast installation as indicated in the equipment data.

5.9 MATERIAL AND CONSTRUCTION

Similar parts, particularly removable one shall be interchangeable.

Exposed parts shall not leave pockets where water can collect.

Internal design of transformer shall ensure that air is not trapped in any location.

Material on contract with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall be not be galvanized or cadmium plated.

5.10 CORE

a) Magnetic circuit shall be of 'Core Type' construction. The core shall be build out high grade, non ageing, low loss, high permeability, cold rolled grain oriented silicon laminations.

b) Finally assembled core shall be free from distoration. It shall be rigidly clamped to ensure adequate mechanical strength and to prevent vibrations during operations.

c) Core shall be provided with lugs suitable for lifting the complete core and coil assembly.

d) Core and coil assembly shall be so fixed in the tank that shifting will not occur during transport or short circuits. 5.11 INTERNAL EARTHING

All internal metal parts of transformer shall be earthed.

5.12 WINDING

a) Winding shall be subjected to shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.

b) Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in hot transformer oil and shall not so often or be otherwise affected under the operating conditions.

c) For dry type transformer, both HV & LV winding shall be cast as one rigid tubular coil, avoiding any ingress of particles. The insulation shall be class F.

d) In case of DYN 11 transformers, neutral shall be brought out in open for solid earthing on the secondary side, separately on the tank.

e) Windings shall be copper wound

f) Winding shall be so designed that it can withstand the specified thermal and dynamic short circuit current.

5.13 TANK

a) Tank shall be made from commercial grade low carbon steel and Shall be of welded construction.

b) Tank shall be designed to permit lifting by crane or jacks of the complete transformer assembly filled with oil. Accordingly the base shall be suitable reinforced to prevent any distortion.

c) Material used for gaskets shall be cork neoprene or approved equivalent.

d) All fasteners and boils etc. shall be galvanised zinc passivated.

5.14 OIL (only for oil type)

a) Transformer shall be supplied with first filling oil conforming to IS: 335

b) Additional 5% quantity of oil shall be supplied in non-returnable tin for each transformer for tapping purposes etc.

5.15 OFF LOAD TAP CHANGER SWITCH –("Off Circuit Tap changer Switch")

Off load tap changing arrangement shall be provided on H.V. side. The tappings shall be provided for variation of HV voltage from +7.5% to –7.5% in steps of 2.5% each with arrangement to lock with pad locks including 2 sets of keys. ANI externally hand operated Off-Circuit tap changing switch with handle, having a position indicating plate and lock device shall be provided.

5.16 ON LOAD TAP CHANGER

On load tap changing arrangement shall be provided on HV side. The range shall be +5% to -15% in 16 steps. Tap changer shall be controlled by a Remote Tap changer control panel.

5.17 TEMPERATURE RISE

Continuously rated for full load, temperature rise shall not exceed 50 deg centigrade by thermometer in oil (55 deg. Centigrade by resistance).

5.18 COOLING (only for oil type)

Natural oil cooling by means of pressed/round tubes/radiators around transformer tank, ONAN type shall be provided.

5.19 ACCESSORIES & FITTINGS

5.19.1 LIFTING LUGS

Arrangement of lifting the active part of the transformers along with the cover of the tank by means of lifting lugs without disturbing the connections shall be provided. Also complete transformer lifting lugs shall be provided. Lifting arrangement for core and coils shall also be provided.

5.19.2 JACKING PADS

Jacking pads shall be provided on the transformer.

5.19.3 EARTHING PADS

2 nos. earthing pads of copper or non-corrodible material on transformer tank and suitable earthing terminals on cable boxes shall be provided.

5.19.4 DIAGRAM AND RATING PLATES

One diagram and rating plate indicating the details of transformer connecting diagram vector group, tap changing diagram etc. shall be provided.

5.19.5 AIR RELEASE

An air release hole with plug shall be provided on the top of the tank cover to facilitate release for entrapped air while filling of oil.

5.19.6 BREATHER

The transformers shall be provided with indicating dehydrating silicagel-breather of sufficient capacity.

5.19.7 OIL VALVES (only for oil type)

Transformers shall be provided with the following oil valves with all free end of the valves blended.

a) Filling valves
b) Main tank drain valve with flanged or threaded connection. The drain shall be so designed that 90% of the oil can be drained off in 10 minutes. c) Top and bottom filter valves
d) Pressure relief device or explosion vent
e) Shut off valve between Buchholtz relay and main tank
f) Shut off valve between Buchholtz relay and conservator

5.20 OIL CONSERVATORS (only for oil type)

Transformers shall be provided with the conservator with welded end plates. It shall be bolted to the cover and enable dismounting for purposes of transport. It shall be provided with oil level guage with marking for minimum level and oil filling hole with a cap which can be used filtering oil. For draining purposes a plug shall be provided. A connection pipe between the conservator and main panel shall be provided which shall project inside the conservator.

5.21 ROLLERS

4 nos. Bi-directional rollers shall be provided to the transformer on cross channels to facilitate easy movement and positioning of the transformer. Suitable arrangement of the rollers shall also be provided.

5.22 THERMOMETER POCKET

A pocket along with 0-120 degree centigrade mercury-in-glass thermometer shall be provided for reading the oil temperature. The pocket shall have water proof, dust proof and weather proof design to avoid contamination of transformer oil under outdoor usage.

5.23 BUCHHOLTZ RELAY

Buchholtz relays suitable for 30 Volts D.C. operation with alarm and Trip contacts with air/gas release cock shall be provided.

5.24 DIAL TYPE THERMOMETER FOR OIL TEMP.

A dial type thermometer of 150 mm dia and with maximum set pointer at 75 degree centigrade shall be provided. The indicating instrument shall have 2 electrical independent contacts for electrical alarm and trip at high temperature and at 2 distinctly different temperature suitable for 30 Volt.D.C.auxilary contacts.

5.25 EXPLOSION VENT

The tank shall be provided with a pressure release device. The device shall be weatherproof and shall be provided with a diphragm. Equaliser pipe shall be connected to the pressure release device (explosion vent) of the conservator.

The vent shall be placed in such a manner so that incase of diaphragm rupture the discharge of oil shall not be on the transformer.

5.26 CABLE AND BOXES

Cables and boxes shall be as follows.

a) On H.V side Cable End Box suitable for 11/22/33 KV, 3 core x 185 sq.mm. XLPE cable

b) On M.V. side Cable End Box shall be suitable to accept busduct/single/multicore PVC insulated cables as specified .

c) Cable terminal box shall be provided with suitable copper flats and flexibles of proper size. Extended copper flats shall be suitable to accept the above mentioned cables.

5.27 MARSHALLING BOX

A marshalling box shall be provided on the transformer to have the following contact blocks.

a) Alarm and trip contacts for Oil Temperature Indicator suitable for 30 Volt D.C. Supply.

b) Alarm and trip contacts for Buchholts Relay suitable for 30 Volt D.C. Supply.

c) 1 no. of filament a type bulb suitable for 230Volt Operation with On/Off switch is to be provided in the Marshalling Box.

5.28 NOISE

Noise levels shall be as per NEMA standards

5.29 TESTING

Transformers shall be subjected to the following tests all the factory before dIspatching the same and test certificates shall be furnished.

a) Measurement of winding resistance
b) Ratio polarity and phase relationship
c) Impedance Voltage
d) Load losses, copper losses
e) No load loss and no load current
f) Insulation resistance
g) Induced over voltage withstand
h) Separate source voltage withstand

5.30 INSTRUCTION MANUAL

Successful bidder shall submit 4 copies of manual complete instructions for the installation, operation, maintenance and circuit diagram. Foundation and trenching detains shall be provide with the transformers.

5.31 REJECTION

The Owners/Architect/Consultants may reject the transformer if during tests or services any of the following conditions arises.

a) No load loss exceeds the guaranteed value by 5% or more.
b) Load loss and copper losses exceeds the guaranteed value by 5% or more
c) Impedance value exceeds the guaranteed value by +/-5% or more
d) The difference in impedance value of any two phases during single phase short circuit impedance test exceeds 2 percent of the average value of guaranteed by the vendor.
e) Oil or winding temperature rise exceeds the specified value by 5 Degree Centigrade.

6.0 H.V. SWITCHGEAR

6.1 SCOPE :

These specifications cover the general design, manufacture, testing, installation and commissioning of 11/22/33 KV Switchgear of Vacuum Circuit Breakers/SF6 as indicated in the equipment data

6.2 STANDARDS :

The equipment shall be designed, manufactured and testes in accordance with the relevant International and Indian Standards. Indian Electricity Rules and Indian Standards Specifications conforming to the latest edition of the following standards in so far as they are applicable shall be followed:

IEC Pub 56/298 - Circuit Breaker

IS 375 - Marking and arrangements for switchgear boards, main connections and auxiliary wiring.

IS 2705 - Current Transformer

IS 3156 - Voltage Transformer

IS 2516 - A.C. Circuit Breaker, above 1000 Volts A.C. IS

3043 - Code of Practice for Earthing

IS 722 - (Part IV) – Three Phase Watt- Hour meter with Maximum demand indicator.

IS 1818 - Isolator and Earthing Switches.

IS 1248 -Direct acting electrical indicating instruments IS

3231 - Relays

IS 8675 - Control Switches and Push

IS 2147 - Degree of Protection provided for enclosures for Switchgears.

6.3 SYSTEM OF SUPPLY

11/22/33KV, 3 Phase, 50 Cycles, earthed system.

6.4 TYPE

Indoor, floor mounting type.

6.5 MATERIAL AND CONSTRUCTION :

The switchboard shall be factory assembled, indoor type metal clad, totally enclosed dead back and fully interlocked design generally manufactured and tested as per IS 25165/1980. The switchboard shall form a continuous board with main supporting frame if fabricated CRCA sheet steel of 14 gauge thickness to form a rigid assembly providing self contained housing for fully draw out type circuit breaker units and associated equipment. Doors and partitions shall be fabricated using 16 gauge CRCA sheets. Design of the board shall permit future extensions at both the ends. The switchboard shall be completely assembled and tested at the manufacturer's works for proper operation and designed for a short circuit capacity of 350MVA/33 KV. The bus bars shall be continuously rated for the ratings specified as per the technical details with levels suitable for 33000Volts, 3 phase, 50 cycles and effectively earthed system.

The switchboard structure shall be divided into two sections. The front section shall comprise of self contained housing for a draw out type circuit breaker units, the top sections shall accommodate the busbars, instruments, relays etc. and the back sections shall accommodate instrument transformers and cable boxes.

The panels shall be designed with adequate space for accommodating the specified cables and terminations of cables and incase of an emergency for easy disconnection of the cables. The cubicles shall be dust and vermin proof. Bottom plates of each cubicle shall be such that the cable openings could be sealed effectively to prevent entry of creeping vermin after installation. All ventilation and other openings provided in the equipment shall have suitable screen protection by fine brass wire mesh. Draw out portion of the circuit breakers shall be interchangeable.

Circuit breakers shall be with manual spring charging mechanism.

Circuit breakers shall be provided with necessary auxiliary contacts for indication, control, interlocking or other purposes. Excluding the contacts already used for the circuits, a minimum of four spare sets of contacts with two ' NO' and two 'NC' shall be left free in each unit.

Busbars and jumper connections shall be insulated with suitable sleeves.

Voltage transformer shall be insulated for full voltage rating and shall be Cast Resin Type. Secondary winding shall be rated for 110 volts RMS. High voltage HRC fuses of full interrupting rating shall be provided. Fuses shall be mounted for easy accessibility for replacement with safety while the main busbars are live. The VA rating of PT shall be adequate to meet the VA burden of all meters, relays together with 10% spare capacity.

Current transformer shall be mounted in such a way that they do not come in the way of jumper connection to break isolating contacts. Each CT shall be of proper accuracy as per relevant standards for metering and protection, with adequate burden. CT shall be cast resin type having bar/wound primary. Meters, relays etc. shall be flush mounted preferably on a hinged metering panel in front of the switchboard permitting ready access to small wiring, terminal board, instruments, fuses etc. Each unit shall be equipped with metering and indication as called for in the scheduled of quantities. Instruments shall preferably have square size and shall be vibration proof with proper accuracy.

Circuit breaker unit shall be suitable for short circuit symmetrical breaking current rating of 20 KA at 22KV, RMS.

6.6 CLOSING SYSTEM

Manually charged spring power closing mechanism shall be provided for the breakers. The operating mechanism shall be TRIP FREE design.

6.7 TRIPPING SYSTEM

Shunt trip coil suitable for 30 Volts DC battery supply shall be provided. 1.5.14 Breaker elements shall be withdrawable in three distinct positions as follows:

a) Fully plugged in (Service)
b) Fully withdrawn, and
c) Test.

In test position, the breaker element shall safely be isolated from the fixed contacts of the breaker. In the test position, it should be possible to close or trip the breaker over the control switch for testing purpose provided on respective breaker panel. Necessary interlocks shall be provided for the relative positions of the breaker element to facilitate fool-proof operation and maintenance.

6.8 MECHANICAL SHUTTERSThe circuit breaker shall be horizontal draw out type with provision of automatic shutters over primary isolating contacts and positive interlocking to prevent the operation of the circuit breaker unless it is fully plugged in or isolated and also locked in either position.

6.9 INDICATING LAMPS

a) All indicating lamps shall be of the filament type suitable for continuous operation of 110 Volts AC.

b) All indicating lamps shall be of low Watt rating.
c) The lamps shall have Red, Green, Amber and White covers and out of temperature resistant prismatic glass or plastic.
d) Bulbs and lenses shall be easily replaceable from the front.
e) ON lamps – Red colour, Off lamps – Green colour, white lamp – Trip circuit healthy and Amber for Auto trip

6.10 METERS

All indicating meters shall be of 96 sq. mm size and suitable for flush mounting.

6.11 RELAYS

a) Relays shall be :
b) Enclosed in dust proof flush mounting cases.
c) Accessible for setting and resetting from the front.
d) Providing with positive acting hand reset flag indicators visible from the front.
e) Auxiliary relays shall be rated to operate satisfactorily between 70% and 110% rated voltage.

6.12 SELECTOR SWITCHES

Selector switches shall be of the rotary type and adequately rated for the purpose intended. Minimum acceptable rating is 10 Amps, continuous at 240 Volts.

6.13 EARTHING

Main copper earth bar shall be 25 mm x 6 mm for the full length of switchboard. Provision shall be made for connections from the earth bar to the substation earth on both sides of the switchboard.

6.14 DRAWING AND LEAFLETS

Two sets of illustrative literature and dimensional drawings shall be submitted with the tender. The successful bidder shall provide 3 copies of manual of complete instructions for the installation, operation, maintenance and repairs. Circuit diagram, foundation and trenching details shall also be provided with the tender.

6.15 TESTING

H.V. Switchboard shall be subjected to tests specified in relevant Indian Standards before despatching and test certificates shall be furnished in triplicate. Only routine testing shall be carried out at the manufacturer's works. The manufacturer should produce the certificate for type test.

7.0 CABLING

7.1 SCOPE

The scope under this section covers the following:

A) Power cables HV and LV
B) Control cables

7.2 STANDARDS

The following standards shall be applicable:

A) IS : 1753 : Specification for aluminium conductors for insulated cables
B) IS : 2982 : Specification for copper conductors in insulated cables
C) IS : 5831 : Specification for PVC insulated and sheath of electric cables
D) IS : 6474 : Polythelene insulation and sheath of electric cables
E) IS : 3975 : Specification for mild steel wires, strips and tapes for armouring of cables
F) IS : 692 : Paper insulated lead-sheathed cables for electricity supply
G) IS : 694 : PVC insulated cables
H) IS : 1554 : PVC insulated (heavy duty) electric cables
I) IS : 4288 : PVC insulated & PVC sheathed solid aluminium conducted cables of voltage rating not exceeding 1100 V.
J) IS : 5755 : Mineral insulated aluminium sheathed cable with aluminium conductors
K) IS : 1255 : COP for installation and maintenance of paper insulated power cables (upto and including 33 KV)
L) IS : 7098 : Specification for cross linked polyethylene insulated PVC sheathed cables
M) IS : 5959 : Polythene insulated and PVC sheathed (heavy duty) electric cables
N) BS : 2004 : PVC insulated unarmoured cables for electric power & lighting.
O) IS : 6380 : Electrometric insulation and sheath of electrical cable
P) IS : 3961 : Recommended current ratings of cables
Q) IS : 5819 : Recommended short circuit ratings for high voltage PVC cables

7.3 GENERAL REQUIREMENTS

The cables shall be either copper or aluminium as indicated. The HV cables shall be of paper insulated, PVC or XLPE and the M.V cables shall be of PVC or XLPE as indicated in the drawings and schedule of materials. 3.2 Power cables shall comply of the following

- HV cables to suit the system voltage
- MV cables -1100 V grade with standard copper conductors upto and including 6 mm sq. and standard aluminium conductors for 10 mm sq.
- Colour coded insulation
- PVC inner and outer sheathing applied for extrusion - Steel armouring between inner and outer sheathing

Control cables shall be 600V grade multi-core copper conductor with PVC insulation, armouring and sheathing. The cable sizes shall be selected to carry the continuous full load current, with stand short circuit currents and bring the voltage drop within the specified limits.

7.4 CONDUCTORS

The copper conductors shall comply with the requirements specified in IS : 2982 and aluminium conductor IS : 1753.

7.5 INSULATION

The type of insulation shall be as indicated in the drawing and bill of materials. The thickness of insulation shall be on the basis of insulation material, voltage and the conductor size conforming to the relevant standard specification. The cores shall be colour coded to Indian Standard Specifications.

The XLPE cables shall be with chemically cross-linked polythene of natural unfilled compound. The PVC insulation & sheathing shall be of high quality & conforming to the following :

- Volume resistivity @ 278 5.12 x 10
- Tensile strength 125 kg/cm
- Elongation 125%

7.6 SHEATHING

The sheathing shall be PVC and shall be before and after the armouring, the thickness of the sheathing shall be based on the conductor size and overall diameter below the sheathing.

7.7 ARMOURING

Single core cables shall be without armouring. But it insisted it shall be of magnetic material. Multi core cables shall be with armouring. The armouring for cables upto 16 mm sq. shall be galvanized wire armoured and above 25 sq.mm shall be steel strips.

7.8 INSTALLATION

Power cable laying shall strictly be as follows : In full length without joints or splices. - Mark the routing on drawings and at site and get it approved, if the routes are not available on drawings.

- Cable trays to be used for cables laid indoors except for single cables. The cable trays shall be of ladder type fabricated out of structural steel, GI perforated or aluminium perforated as indicated. The cable trays shall be of adequate strength to carry the weight of cables without sagging. Structural brackets grounted in the build up trenches to support the cable such supports shall be at intervals of not less than 750 mm centres.

All the structural steel work shall be finished with two coats of paint over primer. - Spacing of cable support for self supported cables on wall, ceiling or trenches shall be as follows :

Horizontal run	Vertical run
Upto 10 mm 350 mm	450 mm
16 to 95 mm 450 mm	500 mm
120 to 400 mm 700 mm	900 mm

- For cables laid indoors, plastic identification marks at every 20 m straight run, at bends & both ends.
- Cables laid underground shall be at a depth not less than 600 mm with sand bedding & protective bricks or tiles extending at least 100 mm on both sides. Markers to be provided above ground at bends, loops & crossing.
- Provide humepipes, trenches or tunnels at built-up areas & road crossings.
- Provide loops of minimum 500 mm radius at each ends.

- Cable should not be bend to a radius of not less than 20 times the diameter of the cables.
- Individual cable shall be clamped with saddle, clamp, spacer etc.
- Cables on trays shall be tied using lockable nylon ties of appropriate length.

Control cables shall be laid away from the power cables & shall be on suitable trays.
The power cable termination shall have necessary brass glands & shall be as follows :
- Pressure clamp insertion type upto 4 sq.mm
- Tinned copper termination shall be through pressure clamp insertion type lugs.

7.9 TESTING

HT & LT cables shall be tested after installation using 1000V & 500V insulation resistance tester respectively and the following readings recorded:
- Continuity on all conductors
- Insulation resistance

A) Between conductors
B) All conductors & ground

8.0 MV SWITCHGEAR

8.1 SCOPE

The scope under this section covers supply and or installation, testing and commissioning of Main MV panels & switchgears.

8.2 STANDARDS

The following standards shall be applicable:

A) IS : 3072 COP for installation & maintenance of switchgears
B) IS : 4237 General requirements for switchgear & control gear for voltage not exceeding 1000V.
C) IS : 375 Marking and arrangement for switchgear busbars, main connection and auxiliary wiring.
D) IS : 2147 Degree of protection provided by enclosure for low voltage switchgear & control gear.
E) IS :139497 Specification for low voltage switchgear & control gear F) IS : 5987 COP for selection of switches voltage not exceeding 1000V.
G) IS : 1818 AC isolators & earthing switches.
H) IS : 4047 Heavy duty air break switches and composite units for air break switches and & fuses for voltage not exceeding 1000V.
I) IS : 4064 Normal duty air break switches and composit unit for AB switches & fuses for voltage not exceeding 1000V.
J) IS : 2607 Air break isolators for voltage not exceeding 1000V.
K) IS : 8623 Specification for factory built assemblies of switch gears and control gears for voltage including 1100V AC & 1200 V DC. L) IS : 13703 HRC fuse links upto 1000V AC.
M) IS : 3106 COP for selection, installation and maintenance of fuses voltage not exceeding 650 V.
N) IS : 2959 AC contactors for voltage not exceeding 100V.
O) IS : 3914 COP for selection of AC induction motor starters

P) IS : 5124 COP for installation and maintenance of AC induction motor for voltage not exceeding 1000V.

Q) IS : 1822 AC motor starters for voltages not exceeding 1000 V.

8.3 GENERAL REQUIREMENTS

The MV switchgear shall meet the requirements shown on the drawings. They shall be 1000 V grade suitable for the system short circuit capacity and rated current carrying capacities and shall comply the following features. A) Incoming & outgoing feeders.

B) Starters and contactors

C) Busbars and feeder connections

D) Meters, relays indicating instruments E) All interconnection & wiring

F) Sheet steel enclosure.

8.4 The switchgear shall be cubicle or industrial type as indicated on the drawings and schedule of material and shall meet the specifications of components indicated.

8.5 CUBICLE PANELS

The panel shall be fabricated out of CRCA sheet steel enclosure having combination of 14 & 16 SWG thickness, free standing, totally enclosed, extensible modular construction. The panels shall be provided with 7 tank anticorrosive treatment. The panel shall be finished with 2 coats of approved synthetic enamel paint/powder coated over two coats of red-oxide primer, oven dried.

The panel shall be dead front, components accessible from front for maintenance, panels having depth of 800 mm and above can have accessibility. For busbars and cables from back, subject to space availability on the rear side of panels.

Independent vertical compartments for busbars, feeders and cables with sufficient clearance and accessibility for maintenance of all components and connections. The cable entries shall be suitable for both top and bottom entry, unless specifically indicated otherwise. Non-cubicle panels (open type) also could be used with the approval of Consultants and if indicated in the bill of material specifically.

Each feeder shall be totally enclosed, self sufficient with ACB/MCCB/SF unit, contactors, starters, meters, relay indicators, interlocking doors, padlocking facility, labelled terminal block, engraved plastic labels indicating feeder details.

Each panel shall be adequately ventilated with louvers & shall be protected with wire mesh from inside. The maximum height of the operating handle/push button shall not be more than 1990 mm in the case of main panel and 1750 mm for other panels and MCC's unless specially approved by Consultants.

Each chamber shall be provided with concealed hinged door of not less than 14/16 G thick, machine cut opening for mounting relays, meters, PB's and indicators. The doors shall be provided with neoprene gasket of good quality. Door shall be earthed to the body of the panel.

Earthing of non current carrying metal parts shall be connected to the earth busbars. Feeder components shall be mounted on 2.5 mm thick M.S. top & bottom plates of the cable chambers shall be removable sectionalized to mount cable glands.

Base frame work of minimum ISMC 75 shall be provided for all floor mounted panels and angle iron brackets for wall mounted type.

8.6 BUSBARS

The busbars shall be of air insulated electrolytic grade aluminium/ copper as indicated in the drawing or schedule of material and shall comply with the following.

A) Uniform cross section with 35 C rise above ambient and with colour coded PVC heat shrinkable sleeves.

B) Branch busbars rated for 75% of aggregated capacities of the feeders connected.

C) Neutral busbar of size 50% of phase bars.

D) Earthing busbar of size similar to neutral busbar subject to a maximum of 150 sq.mm copper or 250 sq.mm Aluminium

E) Non hydroscopic moulded (SMC/DMC) supports to withstand thermal and dynamic short circuit loads, equivalent to 35 m VA at 415 V.

8.7 AIR CIRCUIT BREAKER

The air circuit breakers shall be double break, quick make, quick break, trip free horizontal draw out type and shall comply the following features. A) Ultimate breaking capacity (ICU) of 50-65 KA. B) Rated breaking capacity (ICS) of 50 – 65 KA

C) Making capacity of (ICM)100-150 KA.

D) Anti welding, anti arc traveling silver alloy main and arcing contacts with arc chute.

E) Triple pole direct acting and temperature compensated over current releases suitable for discrimination with up and down stream feeders.

F) Serve, test isolation and maintenance position setting with locking facility in any position.

G) Isolation plugs, safety shutters and interlocking facility.

H) CT operated overload and short circuit relays for all breakers with microprocessor controlled

I) Under voltage and earth fault relays for incoming breakers, preferably microprocessor based in built. Meters and indicators shall be provided as shown in the drawing along with BMS connectivity port, if required.

8.8 MOULDED CASE CIRCUIT BREAKERS

The MCCB's shall be of double break, quick make, quick break trip free operation shall comply the following features.

1) Interrupting capacities for different rating in KA at 415V, 50 Hz, 0.2 PF.
   a) Upto 100 A. - 35 KA
   b) Above 100 & upto 800 A - 50 KA

2) Non welding silver alloy main contacts and arcing contacts with arc chutes.

3) Inverse time instantaneous O/C, temperature, compensated adjustable and integral tripping mechanism.

4) Moulded, heat resistance resin bonded fibre glass or phenoltic material housing.

5) Under voltage and current operated earth fault releases for incoming MCCB's and earth fault releases to operate on 1 to 2A for CCB's used at power outlets shall be provided wherever shown on the drawing.
6) Extended handles for MCCBs of 200A & above.
7) All MCCBs 250 Amps above shall have microprocessor based releases capable of sensing true RMS
8) All breaking capacity specified are ICS and ICS = ICU

8.9 SWITCHES AND SWITCH FUSE UNITS

The switches and SF units shall be of AC 23 duty and shall comply the following features.

A) Quick make, quick break, double break silver alloy contacts with arcing horns of chutes.
B) Common operating handle.
C) Switch fuse units of combination fuse switch type with fuses on phase circuit and copper solid links for neutral circuit for TPN and DP units. D) Fuses shall be of min. 30 KA short circuit rates.

8.10 STARTERS

The starters for rotating machines shall be as follows unless indicated otherwise.

A) Upto 10.0 HP Direct on line
B) 12.5 to 40.0 HP Star Delta
C) Above 50 HP As specified

8.11 The starters shall comply the following features.

A) Main and auxiliary contacts of required capacity with 240 V coils and 2 numbers NC and NO spare contacts each.
B) Automatic change over for star delta with adjustable static timer.
C) Bi-metallic over load relays and single phase prevention relays with manual reset etc.
D) Start stop push button/auto-off-manual switch as indicated in the schedule of material.
E) Internal wiring and accessories including CT's wherever required
F) Indicating lamps with 2A control fuses.

8.12 AUXILLARY EQUIPMENTS

The auxiliary equipments such as instrument transformers, meters, relays, indicating lamps etc. shall be as specified.

8.13 BUSDUCTS

The busducts shall be 1000 V grade totally enclosed with sheet steel having thickness of minimum 16 SWG. It shall be ventilated adequately with louver and louvers shall be covered with wire mesh from inside.

The busbars, busbar supports and sheet steel treatment shall be same as specified for the panels. The busducts shall be provided with right angle bends wherever necessary and flexible connections at both ends.

8.14 INSTALLATION

The switchgears shall be mounted 100 mm above the floor with necessary steel frame or masonry footings.

The panels shall be thoroughly cleaned before commissioning and shall be made dust and moisture free using hot air blowers.

The panel shall be provided with two earth connection of sufficient capacity. The bus ducts shall be mounted at the location shown on drawings with adequate supports. The spacing between the supports shall not be more than 1.0 metre.

The bus duct shall be provided with 2 nos. earth connection terminals of sufficient capacity.

8.15 TESTING AND COMMISSIONING

The MV switchgear shall be subject to factory inspection before finishing and despatch, unless inspection is waived. The following test are to be carried out and necessary certificates submitted.

A) Routine test certificates for ACB's and MCB's.

B) Insulation resistance test with 1000V megger with all switchgear in closed position.

   1) Phase to phase 2.5 MEG. OHMS

   2) Phase to neutral 1.5 MEG. OHMS

C) Secondary wiring and apparatus should withstand 2000 V for one minute.

D) Meters and relay calibrated and tested through secondary injection tests. Test certificates shall be submitted.

E) Capacitors

   - Insulation resistance of 50 M ohms. after 1 minute charge with 500 V DC.
   - To withstand 2500 V AC for 1 minute - Functional test for APFC relay.

9.0 EARTHING & LIGHTNING PROTECTION

9.1 SCOPE

The scope of this section shall cover the following:

A) Earthing station

B) Earthing conductors

C) Earthing of equipments and installation

9.2 STANDARDS

The following standards shall be applicable :

A) IS : 3043 COP for earthing

B) IS : 5216 Safety procedures & practice in electrical work

C) IS : 2309 COP for the protection of buildings and allied structures against lightning

9.3 MATERIAL

The material for earthing system shall be one of the following as indicated in the drawing and schedule of material. Copper-Aluminium-GI

9.4 EARTHING STATION/TERMINATIONS

The earthing station shall be generally as indicated in IS : 3043 shall include :

- 600 x 600 x 3 mm copper or 600 x 600 x 12 mm GI plate for plate earthing
- 50/75 mm dia 2500 mm long perforated GI pipe for pipe earthing
- Soil treatment with alternate layers of salt and charcoal
- Masonary chamber with hinged cast iron cover, watering pipe and funnel.
- Test link

The resistance of each station should not exceed 5 ohms. The no. of earthing station shall be as shown on the drawing.

9.5 EARTHING CONDUCTORS

Earthing conductors shall be of copper, aluminium or GI as shown in the drawing and schedule of material. Copper conductors shall be with a phosphorous content of less than 0.2% GI and aluminium conductors buried in ground shall be provided with protective coatings and wrappings.

There shall be minimum of one earth connection to single phase loads and two numbers for three phase. The sizes of earth conductors for equipments, switchgears etc. shall be as shown on the drawings.

9.6 CABLES

A) Armoured Earthing of armouring at both ends

B) Unarmoured Continuos bare conductor or insulated conductor along with cable.

9.7 CONDUIT WIRING

A) Metallic & Non metallic Insulated conductor run inside the conduit

NOTE

1) The earth conductors for cables and conduits shall be of 50% of the phase conductor subject to a maximum of 120 sq.mm and a minimum 2.5 sq.mm copper.

2) The equivalent size of aluminium and GI conductors shall be 1.4 and 3 times the copper size respectively.

9.8 INSTALLATION

The earth station shall be made by excavating the ground to a depth of not less than 2.5 m and the excess earth after back filling shall be removed from site. Ground with rocky strata, the depth of excavation shall be less.

However, additional earthing stations or earth matting to be provided to achieve the system earthing less than one ohm. The earth conductors shall be fixed to the wall/columns etc. at every 500 mm centres with 10 mm spacers. The total earthing system shall be mechanically and electrically connected to provide independent path to earth.

9.9 TESTING

The following earth resistance values shall be measured with earth meggar and readings recorded.

A) Each earthing station

B) Earthing system as a whole

C) Earth continuity conductors

10.0 DISTRIBUTION BOARDS

10.1 SCOPE

The scope under this section cover the sub-distribution boards and feeder pillars for lighting and power distribution.

10.2 STANDARDS

The following standards shall be applicable :

A) IS : 2607 Air break isolators for voltages not exceeding 1000 V.

B) IS : 13032 Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000 V.

C) IS : 2086 Carrier and base used in rewireable type electric fuses upto 650V.

D) IS : 3106 COP for selection, installation and maintenance of fuses- voltage not exceeding 650 V.

E) IS : 5039 Distribution pillars for voltage not exceeding 1000 V. F) IS : 8828} Miniature circuit breaker. IEC : 898}

10.3 GENERAL REQUIREMENTS

The distribution boards shall be complete with:

- Sheet steel enclosure of 16 SWG suitable for recessed semirecessed or surface mounting or of thermoplastic/ABS body.
- Electrolytic grade copper, busbars, incoming and outgoing feeders
- Earthing terminals
- Circuit diagram indicating load distribution on the inside cover - Weather proof enclosure and canopy for outdoor DB's and feeder pillar. - Double door vertical or horizontal.

10.4 ENCLOSURE & FABRICATION

The fabrication of the enclosure shall comply the following.

- 16 SWG sheet enclosure with circular knock-outs - Wire race for individual phases.
- Phase barriers of insulating material for three phase DB's
- 2 nos. earthing terminals with lug type connection

10.5 Wherever wiring is with 3C –flexible wires, minimum space of 150 mm shall be provided between MCB & enclosure all around as well as between MCBs of different phase.

10.6 CORROSION TREATMENT

Sheet steel work shall be provided with 7 tank anticorrosive treatment. The panel shall be finished with 2 coats of approved synthetic enamel paint over two coats of red-oxide primer, oven dried.

10.7 BUSBARS

The busbars shall be as follows :

- The electrolytic grade copper bar suitable for incoming feeder with current carrying capacity of min. 800A/sq. inch.
- Individual phase and neutral bars located in respective phase cubicle for three phase DB's.

10.8 MINIATURE CIRCUIT BREAKERS

The MCB's shall comply the following feature :

- Short circuit capacity of minimum 9 KA
- Quick make, quick break, non welding silver alloy contacts suitable for manual and automatic operation
- Inverse time over load and instantaneous short circuit tripping mechanism with trip free operation.
- Common operating handle and integral tripping for multiple MCB
- Pressure clamp terminals for users upto 4 mm sq. and bolted lugs for higher rating.
- Phenol formaldehyde moulded enclosure.
- B curve for lighting d curve for UPS supply & c curve for motor duty (AC etc.).

10.9 FUSES

The fuses shall comply the following features:

- HRC link type with carriers
- Short circuit rating of minimum 25 KA
- Pressure clamp terminals for wires upto 4 mm sq. and bolted lugs for higher rating.

10.10 INSTALLATION & TESTING

The distribution boards shall be mounted on necessary angle crow frame work. Insulation resistance shall be tested with 1000V meggar and the values should be as shown below:

- Between phases : 2.5 megohms
- Between phases & neutral : 1.5 megohms

11.0 WIRING INSTALLATION

11.1 SCOPE

The scope under this section covers wiring installation consisting of :

A) Lighting circuit
B) Power circuit
C) Equipment & machinery
D) Low voltage installation

11.2 STANDARDS

A) IS : 732 COP for electrical wiring installation (system voltage not exceeding 650 V)
B) IS : 1646 COP for fire safety for buildings (General) electrical installation
C) IS : 5216 Guide for safety procedures & practice in electric work.
D) IS : 4648 Guide for electrical layouts on residential buildings
E) IS : 302 General & safety requirements for light electrical appliances
F) IS : 9537 Specification of conduits for electrical installation
G) IS : 1653 Rigid steel conduits for electrical wiring.
H) IS : 2509 Rigid non metallic conduits for electrical installation
I) IS : 3480 Flexible steel conduits for electrical wiring
J) IS : 3667 Fittings for rigid steel conduits for electrical wiring
K) IS : 3837 Accessories for rigid steel conduits for electrical (wiring)

L) IS : 6946 Flexible (pliable) non-metallic conduits for electrical installation.
M) IS : 3419 Fittings for rigid steel conduits for electrical wiring
N) IS : 694 PVC insulated wires
O) IS : 8130 Conductors for insulated electric cables & flexible cords
P) IS : 5133 Boxes for enclosures of electrical accessories
Q) IS : 2148 Flame proof enclosure for electrical apparatus
R) IS : 1293 3 pin plugs and sockets
S) IS : 4705 Switch socket outlet (non-inter locking type)
T) IS : 5561 Electrical power connectors
U) IS : 2004 PVC insulated wires

11.3 CONDUIT WIRES

Conduit wiring shall be from LDB, PDB, panels, MCC or isolators as indicated and shall be complete with:

- Conduit & accessories
- Wires & interconnections
- Control switches & sockets
- Outlet boxes with terminal connectors & earthing

11.4 NON-METALLIC CONDUITS

Non-metallic conduits shall be heavy/medium guage PVC as specified in schedule of work as per IS : 9537 with following dimensions subject to tolerances. All accessories shall also be of the same material.

	NOM. DIA	ID	OD
1)	20 dia	15.8	20
2)	25 dia	20.6	25
3)	32 dia	26.6	32
4)	40 dia	34.4	40

11.5 METALLIC CONDUITS

All conduits & accessories shall comply the following features:

- Solid welded pipes with black enamelling
- Wall thickness of

16 SWG upto 40 mm dia
14 SWG above 40 mm dia

- Conduit accessories of similar wall thickness & include bends, elbows, junction boxes, reducers, nipple, splitter coupling plugs, etc.
- Junction boxes shall be with the required number of outlets & cover 50/75 mm deep as per site conditions.

- Flexible conduits made out of continuous length of spirally wound, inter-linked strip steel with fired zinc coating on both sides.
- Flexible HDPE pipes short length of upto 500 mm may be used as adaptor for drop to the fixtures wherever false ceiling is there.

11.6 WIRES

Wires shall comply the following features:

- PVC insulated bright annealed copper stranded conductors.
- 600 V grade wires for single phase circuits and 1000 V grade for 3 phase circuits.
- Colour coded as below :

Phase - R - Red
Phase - Y - Yellow
Phase - B - Blue
Neutral - Black
Earth - Green or yellow/green

11.7 CONTROL SWITCHES AND SOCKETS

The control switches and sockets shall be of rated capacity and shall comply the following features:

A) CONTROL SWITCHES

- Silver contacts with shrouded current carrying terminals
- Moulded urea formaldehyde casing and cover plates

B) SOCKET OUTLETS

- Brass or copper female outlets enclosed in urea formaldehyde or porcelain casing
- Control switches & fuses
- Urea formaldehyde cover plates

C) INDUSTRIAL OUTLETS

- Brass or copper female outlet enclosed urea formaldehyde or porcelain casing.
- Aluminium alloy enclosure with cover
- Scraping in earthing terminals
- DP/TP MCB

D) OUTLET BOXES

The outlet boxes shall be factory fabricated out of machine pressed sheet steel passivated as per the switch manufacturer.

11.8 LAYING OF CONDUITS

The size of conduit shall be selected on the following basis:

	Conduit size mm dia						
Wire sq. mm	20	25	32	40	50	63	Maximum number of wires

1.0			4	8	10	x	x	x 1.5
		4	8	10	x	x	x 2.5	
	4	6	8	x	x	x		
4			2	4	6	x	x	x
6			x	2	4	x	x	x
10			x	x	2	4	x	x 16
		x	x	x	x	4	x	
25			x	x	x	x	4	x
35			x	x	x	x	x	4
50			x	x	x	x	x	4

Note: x indicates not applicable

The conduit laying shall be as follows :

- On the routes indicated on the drawing or to be marked on the drawing and at site and got approved before laying.
- Conduit junction boxes/pull through boxes to be installed at spaces not more than 12 m or two 90 deg. bends, the junction boxes shall be flush with ceiling.
- Conduits to be kept 100 mm minimum from pipes and non electrical services - Separate and colour coded conduits/runways to be used for 1) Lighting circuits
  2) Emergency lighting circuit
  3) Power circuit
  4) Low voltage circuit
- Fixing screws to be rust proof or cheese head screws
- Conduit buried in concrete to be fastened to the reinforcement and get approved before casting the slab.
- Conduits embedded in wall to be fixed by staples at 500 mm intervals.
- Conduits embedded in floor screen to be of PVC or galvanized and painted with emulsified bitumen
- Conduits to be free from sharp edges and burrs and necessary PVC bushing to be provided wherever necessary.
- Outlet boxes to have minimum size of 50 x 50 x 32 mm or as per switch manufacturer's specification.
- Flexible conduits are acceptable only at machine end and for short extension to outlets (not exceeding 500 mm in false ceiling)
- Chasing the brick wall shall be done by cutters/circular discs.
- All metallic conduits and accessories shall be threaded type and exposed threads and bends shall be given one coat of black enamel paint over a coat of redoxide paint.
- Non-metallic conduit shall be jointed using solvent specified by the conduit manufacturers.

11.9 EARTHING

Insulated earth conductors of specified size shall be taken through the conduits.

The size of earth wire shall be of size 50% of phase conductor subject to a maximum and minimum shown below :

	Copper	Aluminium	GI
Minimum (sq.mm)	1.5	2.5	4
Maximum (sq.mm)	150	175	350

All outlet boxes, switch & socket boxes, and light fitting to be earthed properly.

The switch/socket outlet shall be factory built suitable for the particular make of switch/outlet.

11.10 WIRING

The wiring in conduit shall comply the following :

- Single core PVC insulated copper aluminium wires as specified below or as shown on drawings and schedule of material
- Wire sizes

	Copper	Aluminium
Light circuit point	1.5 sq.mm	2.5 sq.mm
Light secondary point	1.5 sq.mm	2.5 sq.mm
Power points	2.5/4.0 sq.mm	4.0 sq.mm
Machineries	According to the load current	

11.11 A maximum 3 circuits of same phase can be taken per conduit and each circuit shall have independent neutral and earth wire from DB.Jointing of wires are not permissible, however looping may be done from the circuit point/secondary points.

Metalic/non-metalic trunking may be used if number of conduits aremany. The metalic trunking shall be earthed securily at DB end and throughout the length. Single trunking with metallic partition may be used for different voltage services.

11.12 TESTING

The entire installation to be tested for :

1) Insulation resistance
2) Earth continuity
3) Polarity of single pole switches

3 copies of test certificates shall be submitted for the approval.

12.0 LIGHT FITTINGS AND FANS

12.1 SCOPE

The scope of this section covers light fittings, lamps, ceiling fans and exhaust fans.

12.2 STANDARDS

The following standards shall be applicable:

A) IS : 3646 COP for interior illumination
B) IS : 1913 General and safety requirements for electric lighting fittings.
C) IS : 7027 Transistorised ballasts for fluorescent tubes
D) IS : 1534 Ballasts for fluorescent lamps
E) IS : 6616 Ballasts for HPMV lamps
F) IS : 2215 Starters for fluorescent lamps
G) IS : 3324 Holders for starters for tubular fluorescent lamps
H) IS : 3323 Bipin lamp holders for tubular fluorescent lamps
I) IS : 1569 Capacitors for electrical discharge lamps
J) IS : 2418 Tubular fluorescent lamp for general lighting services
K) IS : 5081 Glass tubes for fluorescent lamps
L) IS : 481 Tungsten filament miscellaneous electric lamps M) IS : 6701 Tungsten filament miscellaneous electric lamps
N) IS : 2183 Schedule of or HPSV lamps
O) IS : 7023 Methods for tests for HPMV lamps
P) IS : 2147 Degree of protection provided by enclosure for low voltage switch gear and control gear
Q) IS : 4327 General requirement for switchgear and control gear for voltages not exceeding 1000 V.
R) IS : 374 Electrical ceiling type fan & regulators
S) IS : 1169 Electrical pedestal type fans & regulators
T) IS : 2997 Air circulator type electrical fan and regulators U) IS : 6272 Industrial cooling fans (man coolers)
V) IS : 1709 Fixed capacitors for fans.

12.3 GENERAL REQUIREMENTS-FITTINGS

The general requirements for the light fittings shall be as follows:

- Sheet metal mounting frame and enclosure with fixing accessories - Sheet metal white stove enamelled reflector.
- Control gear such as ballast, starter and capacitor
- Lamp holder
- Diffuser and other attachments to reduce glare

12.4 The enclosure for the light fittings and other accessories shall conform to the IS : 2147 and IS : 2148 depending on the location mounting of the fittings. The type of fittings and lamps shall be as indicated in the drawing and schedule of material.

The ballasts shall be of copper wound, open type vacuum impregnated with minimum loss, silent operation and without radio interference or electronic ballasts as indicated in the schedule of material.

The light fittings and the lamps shall be suitable for long life and shall withstand voltage variation of minimum ± 10% .The aircraft obstruction lights shall be of neon cold cathode helix with longer life,or LED type housed inside thick glass dome. The fittings shall be prewired with PVC insulated copper wires of adequate capacity but not less than

1.5 sq.mm copper. The light fittings shall be provided with earthing terminals.

12.5 FANS

The fans shall be driven by copper wound electrical motors housed inside cast aluminium enclosure.

The fans shall be with double ball bearing to achieve smooth and silent operation. The fan assembly and blades in the case of fans other than centrifugal fans shall be of cast aluminium with properly balanced blades.

The fan shall be provided with capacitors for starting up single phase fans and to achieve better power factors for 3 phase fans.

12.6 INSTALLATION

Fans shall be mounted on pre-embedded hook. The drawing of the junction box which shall be got approved. Wherever, pre-embedded hooks are not available anchor fasteners shall be used.

The light fixtures suspended shall include two nos. down rods with ball and socket joints.

For the recessed fittings, the mounting supports shall be taken from the ceiling.

12.7 TESTING AND COMMISSIONING

Fans and light fittings shall be checked for visible damages before installation and proper performance.

13.0 LOW VOLTAGE INSTALLATION

13.1 SCOPE

The scope under this section covers the low voltage installation consisting of:

a) Voice/Data wiring
b) Music wiring
c) Television wiring
d) Fire alarm wiring
e) Access control system

The equipments such as EPABX, telephone instruments, Nurses call control unit etc. are excluded from the scope of this work.

13.2 STANDARDS

A) IS : 732 COP for electrical wiring installation (upto 650V)
B) IS : 9537 Specification of conduits for electrical installation
C) IS : 1653 Rigid steel conduit for electrical installation
D) IS : 3667 Fittings for rigid steel conduits for electrical wiring
E) ------- National Electrical Code
F) ------- Indian Electricity Rules and Regulations
G) BS : 5839 Fire alarm panel
H) IS : 14131 Coaxial cables for TV

13.2 WIRING

The conduiting work for low voltage wiring shall be similar to that for electrical wiring except that there shall be no earthing conductors.

The wires and cable for different LV services shall be as shown below

a) Voice/Data - 4 pair CAT-5e/CAT-6 UTP cable
b) Fire alarm - 1.0 sq.mm or 1.5 sq.mm PVC insulated copper wires of 650V grade with colour coding of brown for positive, white for negative and blue for remote indication or 2C – 40/36 shielded as per the manufacturer's instruction
c) Music - 2C-23/36 or 2C –40/36 multicore cables, colour coded twin twisted PVC insulated copper wires
d) TV - Co-axial PVC insulated copper conductors of wideband type with operation upto 860 MHZ capability, with PE dielectric
e) Access Control - 10C –1.5 sq.mm between reader & controller

The tag block shall be Krone type, modular construction using non soldering/screening connectivity. The tag block shall housed in MS painted enclosure with lockable door.

The cables shall meet or exceed the following specifications

	RG R Foam Series	RG 11 Foam Series IS
Standard IS : 14131	5 CA4	7 CA4
a) Centre Conductor Dia	1.02 mm	1.63 mm
b) Dielectric Dia	4.57 mm	7.11 mm
c) Dielectric material	Cellular PE	Cellular PE
d) Outer Dia.	7.0 mm	10.03 mm
e) Bending Radius	>75 mm	>115 mm
f) Impedance	75 ohms	75 ohms
g) Return loss	>23 Db	>23 dB
h) Attenuation at 20°C	Max.dB/100 Mtr.	Max.dB/100 Mtr.
5 MHz	1.9	1.25
45 MHz	5.25	3.5
300 MHz	11.65	7.38
450 MHz	14.45	9.02
550 MHz	16.1	9.97

860 MHz 20.1 12.52

13.3 FIRE ALARM

13.3.1 FIRE ALARM PANEL

Fire alarm panels in general shall confirm to IS : 2189 and analogue addressable system of single/multiloop type or microprocessor based multizone conventional type. The equipment for the main board shall be compact modular type, neatly wired wall or floor mounting type as specified, totally enclosed, dust and vermin proof type made of 16 SWG dust inhibited MS sheet of suitable size to accommodate accessories as specified, with oven baked finish duly painted with one coat of anti corrosive paint and two coats of synthetic enamel paint of fire red shade. The panels shall be completely solid state design. The primary function of control panels shall be to respond automatically to the operation of one or more detectors to give alarm and to indicate device/area/where the devices are activated. The operation of one or more detectors shall result in simultaneous alarm by the following .

a) The external alarm hooters at floor of actuation
b) A visible indication on control panel of zone/device
c) Audible alarm on control panel itself (common to all zones/loops)

The secondary function on the control panel shall be to indicate the faults within the system. An immediate fault wiring shall be given by an audible and visual signal on the control panel. A fault warning shall be given in case of any of the following occurring.

a) Failure or disconnection of normal power supply
b) Failure or disconnection of stand by power supply
c) Failure or disconnection of battery charging equipment.
d) Short-circuit or disconnection of the leads to trigger devices unless the fault condition reproduce the effect of the operation of a triggered device.
e) Removal of any triggered device of the plug in type or disconnection from its transmitter or power supply.
f) Short circuit or disconnection of any of the leads to alarm sounders external to the control and indicating equipment but if the alarm sounders are connected by a ring circuit, disconnection need not be immediately indicated but should be capable of being detected by the routine test procedure.
g) Rupture or disconnection of any fuse on the operation of any protective devices that would prevent a fire alarm being given.
h) Failure of a scanning device to interrogate the detector or zones at the correct time intervals or failure of any monitoring or interrogation system within the control equipment, such as to prevent an alarm being given.

A facility may also be provided for sending fault signal to remote center.

For conventional panel, there shall be one indicator for fire and one for fault in the control panel corresponding to each zone. Each zone shall have tow bulbs of fire/fault indication. Each indicator shall be clearly labeled with zone no. and inscribed with “Fire”

of “Fault” or “Silence “. Separate indicator must be provided in green for system, standby on etc.

Analogue addressable panels shall have min. 80 character backlit LCD display, for fire, fault, service indications, history and other related data or menu driven basis.
The control panel shall derive 230 volts power from normal supply and the entire fire alarm and detection system shall be suitable for operation on 24 V.D.C. A standby power supply shall be immediately available in the event of failure or normal supply and shall automatically be connected as to maintain the equipment in condition such that fire alarm originating from the operation of detector in separate zone/device can be subsequently given. The standby supply should be capable of maintaining the system in normal operation for a period of not less than 48 hours after the failure of normal mains supply after which sufficient capacity would remain to provide full load operation for at least 30 minutes. The full load would be define as that devices/zones (with a minimum of two zones/devices) and the operation of the fault indicator. The operation of trigger devices in further zones should not result in cancellation of fire alarm existing at that times.

The panels shall have provision of additional of 2 sets contacts duly wired, per zone to cut-off power to the AHU’s during fire. The panels shall have a facility for voice communication as telephone/speaker with necessary microphone, speaker, hand/head set, amplifier etc
Control panel drawing shall be got approved by the Consultants before taking up the fabrication.

13.4 PHOTO ELECTRIC SMOKE DETECTORS

Photo electric detector conventional/analogue addressable should respond to visible as well as invisible smoke generated by smouldering or open fire. If shall basically use photo electric (light scattering) principle to measure smoke density, an electronic circuit, connection contact to the base and easy to clean protective housing.

A response indicator for quick identification of the fire location or convenient testing of the detector as well as protection against reversed polarity and voltage surges must be build-in to the base of the detector., The detector shall be plug in type with provision for connecting remote indicator.

The detector shall also be compatible to work with heat and photo detectors and shall have interchangeable base. It shall be listed with UL/FM and/or approved by TOC/TAC or any other recognized national, international standard. It should preferably also confirm to IS : 11360 .

13.5 HEAT DETECTORS

13.5.1 RATE OF RISE-CUM-FIXED TEMPERATURE TYPE

Heat detectors, conventional/analogue addressable shall be of electronic, thermister or

electro pneumatic type, working on rate of rise and fixed temperature. The rate of rise element shall respond quickly when the temperature rise is 15 deg. F or more per minute. The fixed temperature feature should be entirely independent of the rate of rise element and the operating temperature of fixed temperature element should be set as per the requirement of Is : 2175 (latest) for Grade – I detectors.

13.5.2 FIXED TEMPERATURE TYPE

The fixed temperature heat detectors conventional/analogue addressable shall preferable incorporate replaceable fusible element to provide quick and easy restoration service. The operating temperature of the element should be factory set as per the requirement of IS : 2175 (latest) for Grade – I Detectors.

The heat detectors shall incorporate response indicator facility and to be with two wire system on D.C low voltage. It shall be possible to loop the heat detector with manual push button in the same circuit.

The area of coverage per detector shall depend upon structural/architectural configuration, but generally shall be as per IS : 2189-1988. The detectors shall be either or the approved list of Fire Officer's Committee, U.K/Underwriter's Laboratory, USA or approved by CPRI, Roorkee and ISI marked.

13.6 BREAK-GLASS UNITS (MANULA CALL POINTS)

Each manual call point unit conventional/analogue addressable, shall comprise of a push button or fuse of reputed make enclosed in a M.S. Box/cast aluminium box with provision for cable or conduit coupling. The manual push button shall have the words prescribed in clear bold letter on facial window. " Incase of the fire break glass".

The whole assembly to be enclosed in the box enclosure with all sides covered except the front side. The front side shall be sealed with breakable glass cover using neoprene or equivalent gasket. The glass surface should be minimum 30 sq. cm. in area and glass thickness should not exceed 2 mm.

The box enclosure shall be completely dust, vermin damp and weather proof and provided with chain and hammer attached to it. It shall be made of atleast 16 SWG sheet steel. The complete unit shall be suitable for wall/column mounting with necessary mounting accessories. The complete unit and push button shall be painted signal red (shade no, 537 as per IS : 5 . The internal surface of the enclosure of the box shall be painted white in colour. The external painting shall be synthetic enamel.

13.7 ELECTRONIC HOOTER

The dual tone electronic hooter provided shall be conventional/analogue addressable type and it gives discontinuous/intermittent audible alarm automatically whenever the automatic/manual detector operates and is distinct from the background noise in every part of the premises. All hooters shall produce a similar sound and shall maintain the same during their operation. Hooter shall be complete with electronic

oscillations, magnetic coil (sound coil) and accessories, ready for mounting (fixing) and confirming to IS : 2189- 1988.

13.8 SPEAKERS

The speakers/sound columns shall be of specified rating. The speakers shall be recessed or surfaced mounted type with ABS grille of approved colour and shall have line matching transformer. The sound columns shall be surface mounted with metalic/wooden enclosure and black nylon cloth front. Volume controls shall be continuous type, of specified ratings with off Switch.

13.9 TV TAP – OFF

These shall be of ultrawide bandwidth and of hybrid type & bi-directional suitable for Interactive TV system. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance. The tap offs shall be available in one way, two way and four way & eight way configurations. The tap offs shall be available in different tap values ranging from 11 dB, 15 dB, 20 dB & 30 dB to enable uniform signal balancing.

The tap offs shall meet or exceed the following specifications.

	One way	Two way	Four way
a) Tap Loss	15-20 dB	15-20 dB	15-20 dB
b) Through Loss	2.0-0.5 dB	2.5-1.0 dB	3-1.5 dB
c) Isolation	>22 dB	> 22 dB	>22 dB
d) Screening Factor	> 75 dB	> 75 dB	> 75 dB
e) Impedance	75 Ohms	75 Ohms	75 Ohms

13.10 ACCESS CONTROL

The microprocessor based controller shall be operating on 12V DC controlling single or multiple readers with a card capacity not less than 2000. The controller shall have builtin power supply unit to receive 230V AC. The proximity type card reader shall have a range of min. 75 mm with red LED flashing and green on presentation and acceptance of the card. The electromagnetic locks shall operate on 12V DC and shall have a minimum holding force of 275.0 KG. The door position sensor shall be mounted on the door frame and NO contacts closes when the door is closed. The cards shall be proximity type, programmable at site. Necessary logos/screen printing/photo identity shall be carried out along with lamination.

13.11 TESTING

The entire system shall be tested for:

a) Continuity b) Performance

INTERIOR WORKS

CONTENTS

1.0 GENERAL

This Specification is for work to be done, item to be supplied and materials to be used in the works as shown and defined on the drawings and described herein, all under supervision and to the satisfaction of the client. The specification given under is General Specifications and shall be applicable only to relevant items specified in the tender Schedule. In case of brought out items where the model number is mentioned the manufacturer's specifications shall be valid.

The workmanship is to be the best available and of a high standard, use must be made of a special trades men in all aspect of the work and allowance must be made in the rates for so doing.

The materials and items to be provided by the Contractor shall be approved by the client in accordance with any samples which will be submitted for approval by Contractor and generally in accordance with the Specifications. Also if products are specified in the Specification and/or bill of brand, trade name or catalogue reference, the Contractor will be required to obtain the approval of the client before using the materials. The Contractor shall produce all in voices, Vouchers or receipts for any material if called upon to do so by the client.

Samples of all materials are to be submitted to the client for approval before the Contractor orders or deliver the materials at site. Samples together with their packing are to be provided free of charge by the Contractor and should any materials be rejected, they will be removed from the site at the Contractor's expense. All samples will be retained by the client for comparison with materials which will be delivered at the site. Also, the Contractor will be required to submit specimen finishes of colours, fabrics etc. for the approval of the client before proceeding with the work.

The contractor shall be responsible for providing and maintaining and boxing or other temporary coverage's required for the protection of dresses or finished work if left unprotected. He is also to clean out all shelving, out ends and other waste from all pairs of the works before coverings or in-fillings are constructed.

Templates, boxes and moulds shall be accurately set out and rigidly constructed so as to remain accurate during the time they are in use. All unexposed surface of timber e.g. false ceiling, backing fillets, backs of door frames, cupboard framing, grounds, etc. are to be treated with two coats of approved timber preservative before fixing or converging. Only first class workmanship will be accepted. Contractor shall maintain uniform quality and consistency in workmanship throughout.

2.0 JOINERY

2.1 Joinery is to be prepared immediately after the placing of the Contract framed up, bonded and waged up. Any portions that are warped or found with other defects are

to be replaced before wedging up. The whole of the work is to be framed and finished in a workmen-like manner in accordance with the detailed drawings wrought and whenever required, fitted with all necessary metal ties. Straps, belts, screws, glue etc. Running beaded joints are to be cross tongued with teak tongues wherever 1(1/2) thk. Double cross tongued. Joiners work generally to be finished with fine sand/glass paper.

2.2 JOINTS

All joints shall be standard mortise and tenon, dowel, dovetail, and cross halved. Nailed or glued but joints will not be permitted, screws, nails etc. will be standard iron or wire of oxidized Nettle fold tenons should fit the mortises exactly.

Nailed or glued butt joints will not be permitted, exceptional cases with approval of client. Where screws shown on a finished surface, those will be sunk and the whole plugged with a wood plug of the same wood and grain of the finished surfaces will be neatly punched and the hole filled with wood filler to match the colour.

Should joints in joiner's work open, or other defects arise within the period stated for defect liability in the contract and the clause thereof be deemed by the client to be due to such defective joinery shall be taken down, and refilled, redecorated and/or replaced if necessary and any work disturbed shall be made good at the Contractor's expense.

Nails, spikes and bolts shall be of lengths and weights approved by the client. Nails shall comply with IS 1959-1960. Brass headed nails are to comply with B.S.1210. Wire staples shall comply with B.S.1494 or equivalent.

The contact surface of dowels, tendons, wedges etc., shall be glued with an approved adhesive. Where glued, joinery and carpentry work is likely to come into contact with moisture; the glue shall be waterproof grade.

3.0 HARDWARE AND METALS

The hardware throughout shall be of approved manufacture or supplier well made and equal to in every respect to the samples to be deposited with the client. The Contractor may be required to produce and provide samples from many different sources before the client take decision and he should allow his rates for doing so.

Fittings generally shall be brass polished & lacquered, unless otherwise specified and shall be suitable for their intended purpose. In any case, it will have to be approved by client before the Contractor procures it at site of work.

Screws are to much the finish of the article to be fixed, and to be round or flat headed or counter sunk as required. The contractor should cover up and protect the brass and

bronze surfaces with thick grease or other suitable productive material, renew as necessary and subsequently clean off away on completion.

Aluminium and stainless steel shall be of approved manufacture and suitable for its particular application. Generally the surface of aluminium shall have an anodized finish and both shall comply with the samples approved by the client. All stainless steel sheets shall be 304 SS Japan or equivalent with gauge as specified but not thinner than 16 G. All steel, brass, bronze, aluminium and stainless steel articles shall be subjected to a reasonable test for strength, if so, required by the client at the Contractor's expense . All brazing and welds are to be executed in a clean and smooth manner rubbed down and left in the flattest and tidiest way, particularly where exposed. Chromium plating shall be in accordance with I.S. Standard or as per approved specification for normal outdoor conditions and shall be on a base material of copper or brass.

4.0 GLAZIER

All glass to be of approved manufacturer complying with I.S. 3548-1966 as per approved quality and sample to be of the selective qualities specified and free from bubbles, smoke, air holes and other defects.

Polished plate glass shall be "glazing glass" (G.G.) conforming to IS 3438-1965 or as per approved sample and quality. The compound for glazing to metal is to be a special non hardening compound manufactured for the purpose and of a brand and quality approved by the client.

While cutting glass, proper allowance be made for expansion. Each square of glazing to be in one whole sheet. On completion of work clean all glass inside and out, replace all cracked scratched and broken panes and leave in good condition.

5.0 PAINTS & POLISHES

All material required for the works shall be of specified and approved manufacturer , delivered to the site in the manufacturer's containers with the seals etc., unbroken and clearly marked with the manufacturer's name or trade mark with a description of the contents and colour. All materials are to be stored on the site of the work.

Spray painting with approved machines will be permitted only if written approval has been obtained from the client prior to painting. No spraying will be limited in the case of priming neither coats nor where the soiling of adjacent surfaces is likely to occur. The buzzle and pressure to be so operated as to give an even coating throughout to the satisfaction of the client. The paint used for spraying is to comply generally with the specification concerned and is to be specially prepared by the manufacturer for spraying. Thinning of paint made for brushing will not be allowed.

Wood preservative shall be Bison or other equal and approved impregnating wood preservative and all concealed wood work shall be treated with wood preservative. All brushes, tools, pots, kettles etc. used in carrying out the work shall be clean and free from

foreign matter and are to be thoroughly cleaned out before being used with a different type of class of materials.

All iron or steel surfaces shall be thoroughly scraped and rubbed with wire brushes and shall be entirely free from rust, mill scale etc. before applying the priming coat. Surfaces of new wood work which to be painted are to be rubbed down, cleaned, down to the approval of the client.

Surfaces of previously painted woodwork which are to be cleaned down with soap and water, detergent solution or approved solvent to remove dirt, grease etc. While wet the surfaces shall be flatted down with a suitable abrasive and then rinsed down and allowed to dry. Minor areas of defective paint shall be removed by scraping back to a firm edge and the exposed surface touched in with primer as described and stopped with putty.

Where wood work has been previously painted or polished and is to be newly polished, scrapping, burning off or rubbing down.

Surfaces of previously painted metal which shall be painted are to be cleaned down and flattened down as described in surfaces of any rust and loose scale shall be removed completely by chipping , scrapping and wire brushing back to the bare metal and touched in with primer as described .

6.0 POLISH

6.1 FRENCH POLISH

The basic material shall be shellac dissolved in methylated spirit.

Preparation:-The timber must be sanded and cleaned and the grain filled with a grain filler .Any staining must be done before applying the polish.

Equipment :-The polishing rubber the most important implement in French polish shall consist of a pad of cotton wool , which acts as a reservoir for the polish , and a cover of soft white linen or cotton fabric , similar to a well-worn handkerchief which acts as a fitter , the rubber must never be dipped into the polish .; it should be changed by pouring the pouring the polish on to the pad with the cover removed .

Application:- Work evenly over the surface with a slow figure-of-eight motion until the timber is coated with a thin layer of polish. The objective is to apply a series of thin coats, allowing only a few minutes for drying between the coats. When a level and even-boiled surface is obtained the work is ready for the second stage i.e. spiriting off. Allow the work to stand for at least eight hours then take a fresh rubber with a double thickness of cover material and charge it with methylated spirit. The object of spiriting off into and remove the rubber marks and to give the brilliance of finish. Finally, work in the direction of the grain and continue until the surface is free from smears and rubber marks then leave to harden off.

6.2 WAX POLISH

Wax polish shall contain silicones and driers. A good silicon wax is to be used not a creamy or spray. The timber shall be sealed first with another finish such as Ronseal, before applying the

wax.

Application:- Apply a light coat of the sealer by brush or cloth direct to the unfilled timber, working it well in and finishing evenly with the grain. Allow to dry thoroughly then sand lightly with fine abrasive paper. Apply a heavy coat of wax by cloth or on flat surfaces, with a stiff brush. Work it well into timber and finish off by stroking with the grain before leaving to harden. Leave for several hours before rubbing up with a soft brush .Finally; buff the grain with a soft cloth.

Transparent Colored Polyurethane (Melamine) this shall be applied where natural grain of the wood is required to show. Polyurethane gives tough surface which resist chipping, Scratching and boiling water.

Application:- Clean off all grease and wax with an abrasive and white spirit, this should not be applied in humid conditions. Apply the first coat, preferably of clear hard glaze with a cloth pad. Leave this to dry for at least six hours, and then apply further coats with a paint brush. If you wait for longer than 24 hours between coats , rub down the previous coat with fine glass paper or a medium grade of steel wool .Obtain a Matt finish , if required by giving a final coat of clear Renseal Matt coat .

7.0 TIMBER

Only seasoned New Burma Teak Wood or Sal Wood to be used.

All the wood shall be properly seasoned, natural growth and shall be free from worm holes, loose or dead knots or other defects, saw die square and shall not suffer warping, ting or other defects.

The moisture content shall not exceed 12%

All internal frame work shall be treated with approved wood preservative.

All wood brought to site should be clean shall not have any preservative.

All rejected decayed, bad quality wood shall be immediately removed from site.

All wood brought to site must be stacked-stored properly as per instructions.

8.0 PLYWOOD

Plywood/medium density fiber board/teak particle board/ Veneered board etc., as specified in the approved list of manufacturers shall only be used.

Only Fire retardant type exterior grade Phenol formaldehyde bonded, hot pressed ply generally conforming to I.S.I. 5509 of approved make only to be used.

Marine plywood shall generally conform to I.S.710-1980 and also to Defense/ Navy specification bonded, with phenol formaldehyde, treated with wood preservative.

9.0 CARPENTRY WORK

Providing and fixing in position Exterior Grade MDF frame work for partitions upto true ceiling height, panelling, boxing, soffit with vertical members at not more than 450 mm centres and horizontal members not more than 450 mm centres complete including

necessary additional supports, bracing runner etc. complete as per drawing and directions. Items are to be completed in all respects as per drawings & instructions from client. Rate to include applying of approved wood preservative approved make on the finished frame work.

10.0 PANELLING / BOXING

Providing and fixing in position 12mm thick Exterior Grade MDF board. Item are to be completed in all respects as per drawings & instructions from HPCL/MMCI. Rate to include make on the inner side of the board. Actual executed area will be measured.

Providing and fixing 8mm thick Glass in partition of approved make (MODI GUARD / SAINT GOBAIN etc), of appropriate size as per drawings and design with necessary wooden mouldings / biddings to hold the glass in position . All exposed wooden surfaces has to be finished with 2/3 coats of malamine polish. Finishes for Partitions / Panelling, etc

IMPORTANT NOTE: Actual executed area will be measured on one side of partition.
Rate of this item shall include cost of providing fixing wooden facia, if any, matching laminate in approved pattern, skirting, Cornice Moulding at both door level and false ceiling level, Top Cap moulding in case of Low Height Partition etc. as per details and finished in melamine polish of wooden and veneered surfaces for which no extra payment shall be made but shall measured alongwith the partition dimensions. The finishing material shall be fixed in required divisions/ panels/ pattern with proper grooves etc. as per drawings & directions. Item are to be completed in all respects as per drawings & instructions from client. Rate shall include supplying and installing electrical light modular switches as per the ceiling lighting plan and also providing 15nos 5/15 amps modular plug points along with switches in the interior partitionings, rate to include for wiring.

LANDSCAPING & HORTICULTURE

CONTENTS

1.0 SCOPE

The landscape contractor shall from the date of commencement of contract, furnish all materials, labour, and related items necessary to complete the work indicated and specified herein.

The scope of work for the above mentioned work shall include following and shall be carried out as per BOQ, Specification & Landscaping Layout drawings.

The landscape contractor will be generally responsible for the entire site but in particular to works listed below. Along with site management, the responsibilities will include landscaping works and arboriculture works and maintaining the same.

After planting, all planted areas that have exposed soil will have to be mulched with straw or hay. Mulching will be evenly spread to cover any exposed soil.

In addition, the contractor will also be responsible for filling gaps, thinning and transplanting, or replanting where plants may need to be replaced. Along with other planting, the contractor will also be responsible for improving soil conditions for planting. This may include import
/export of sand/soil to/from site. The contractor will also clear vacant area from existing grasses, keep the site clean and maintain the already planted areas free of weeds, pests or insects that cause diseases. All weeds, unwanted grasses and plant material will be cleared up to 1000mm from the edge of planting of newly created and already existing horticultural works (such as boundary trees). The contractor will also be responsible for protection of the plants from salt spray that may occur during the monsoons.

2.0 STORAGE SHED

No storage area will be provided at site by the Employer. As mentioned in General Conditions of Contract, security of materials at site will be the responsibility of the contractor. Any temporary sheds or structures may be built as working space at the area shown at site and on the approval of the Site Engineer.

3.0 WATERING

Water will be made available at only one source at site. If the water on site is insufficient or saline or unacceptable, then the contractor shall be responsible for importing water in water tankers for the general upkeep of the plants. No plants shall be allowed to wither or die due to lack of proper watering.

4.0 PLANT REQUIREMENTS

Plants and shrubs shall be sourced by the contractor from available nurseries, unless otherwise specified. Seeds shall be acquired from reputed organisations and hybrid seeds will be used where possible – particularly for flower varieties. No plant material shall be changed without the consent of the Consultant.

5.0 RESPONSIBILITY

a) The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

b) The contractor shall abide by the Security rules / procedures of the Employer, and shall obtain gate pass, issue I.D. badges to all their employees on site, etc. as prescribed by the Employer.

6.0 MATERIALS & LABOUR

All the materials which are required for the progress of the Landscaping works shall be supplied by the contractor. The required numbers of Labour are to be provided by the contractor.

7.0 PLANTING

Whenever planting, the following specifications will be followed by the contractor. Wherever sand is to be removed, the following specifications shall be followed after refilling the area with good soil.

7.1 DIGGING OF PITS

Tree pits of 600mm x 600 mm x 600 mm (approx. 2'x2'x2') shall be dug a minimum of two weeks prior to back filling. The pits for shrubs shall be 600 mm in depth and 300mm diameter. For ground cover, the land will be prepared by digging up to 300 mm (1') and soil loosened. While digging the pits the top soil may be kept aside, and mixed with the rest of the soil as specified.

If the soil quality is poor, it shall be replaced with soil mixture acceptable to the Consultant. If the soil quality is satisfactory, then it shall be mixed with manure and river sand. The soil condition will have to be approved by the

Consultant. Pest/termite prevention chemicals or any other approved chemical to be applied into the soil before planting as per supplier's specification. When planting is in more than one row, then pits will be dug in a zig-zag fashion ensuring a diagonal planting in each row.

7.2 PLANTING MIXTURE:

The topsoil will be mixed with 15% farm yard manure or coco-peat, 40% red soil, 20% river sand and 20 % excavated earth (topsoil). This mixture will be filled in pits before and after planting.

7.3 BACK FILLING:

The soil is back filled, watered thoroughly and gently pressed down a day previous to planting, to make sure that it may not further settle down after planting.

7.4 PLANTING:

No tree pits shall be dug until a final tree position has been pegged out for approval. Care shall be taken that the plant sapling when planted is not buried beyond the level of the pot containing it. Planting should not be carried out in waterlogged soil.

7.5 STAKING:

If necessary, a single vertical stake 1 meter (approx. 3 ft) longer than the clear stem of the plant, driven 300 mm to 450 mm (approx.1ft to 1'6") into the soil shall be used. Each plant should be secured to the stake so as to prevent excess movement

7.6 WATERING:

The landscape contractor shall allow for the adequate watering of all newly planted trees, shrubs and groundcover immediately after planting and during the following growing season, shall keep the plant material well watered.

7.7 MULCHING:

All planted areas including around trees which have open soil that is exposed will have to be mulched with straw or hay. Rates indicated in the Bill of Quantities shall include such mulching costs. No separate compensation will be paid for mulching

7.8 PROTECTION:

The contractor will be responsible and should take measures to protect the planted saplings from cattle, salt spray and high wind pressure. Rates indicated in the Bill of Quantities shall include such costs of protecting the plants including any physical construction such as walls, tree guards, etc. that may be required for the same.

8.0 LAWN

8.1 PREPARATION:

During period prior to planting the lawn, the area shall be maintained free from weeds, whatever the nature of soil, complete surface shall be trenched over to a depth of 300 – 450 mm. Grading and final levelling of the lawn shall be completed at least 2 weeks prior to the actual sowing.

8.2 SOIL

The soil itself shall be ensured to the satisfaction of Consultant to be a good fibrous loam, rich in humus. Pest/termite prevention chemicals to be mixed if required. Top soil shall be mixed with farm yard manure or coco-peat and mixed with river sand in ratio of 15% manure, 25% river sand, 35% red soil and 25% excavated earth and leveled to maintain positive drainage or specified slopes.

8.3 EXECUTION

Nodes of specified grass shall be dibbled not more than 50mm apart on above mentioned soil conditions. Wherever specified, carpet lawn will used. The carpets will be laid next to each other in an even pattern to ensure that all lawn area is covered. After laying of carpet, it should be lightly pressed into the ground to ensure that it is does not shift, and to ascertain that the roots are in soil. Positive slopes will be maintained to ensure that there will be no low lying areas in center where water logging or pools are created.

8.4 MAINTENANCE

In the absence of rain, lawn shall be watered daily - heavily, soaking the soil thoroughly to a depth of at least 150 mm.

8.5 CUTTING

The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine.

8.6 EDGINGS

These shall be kept neat and must be cut regularly with the edging shears.

8.7 FERTILIZING

The lawn shall be fed once a month with liquid fertilizer by dissolving 45 gms of Ammonium Sulphate in 5 litres of water.

8.8 WEEDING

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

9.0 MAINTAINANCE

Tenderer shall indicate the price schedule for annual maintenance contract for a period of 1 (one) year after the expiry of one year 'Defects Liability period' (guarantee period) in the following format. Charges shall be indicated for 1 (one) year after the expiry of guarantee period. However, payment shall be made on quarterly basis. Maintenance of all items as per BOQ for a period of 1 (One) year after the expiry of one year defects liability period.

10.0 FINAL INSPECTION AND FINAL CERTIFICATE

At the end of the Planting Establishment Period, an inspection will be made by the Superintendent to ensure that all works under the Contract have been finally and satisfactorily executed by the Contractor.

11.0 MEASUREMENT

The measurement for payment to the contractor will be in item wise mentioned in bills of quantities.

LIST OF APPROVED MAKE

1. CIVIL WORKS:

CEMENT	:	ULTRATECH/LAFARGE/ACC/DALMIA
STEEL/REINFORCEMENT	:	TATA/SAIL/VIZAG
VITRIFIED TILES	:	JHONSON/KAJARIA/SOMANY/AGL
CERAMIC TILES	:	JHONSON/KAJARIA/SOMANY/AGL
CEMENT CONCRETE TILES	:	ULTRA/EUROCON / MAA JATYANI, Bhubaneswar
WATER PROOFING COMPOUND:		SIKA/PIDILITE/PERMA CHEMICALS
PAINTS	:	ASIAN PAINTS/BERGER/ DULUX/ NEROLAC
GLASS	:	ASAHI/SAINTGOBAIN
PLASTER OF PARIS	:	BIRLA/JK ALUMINIUM
SECTIONS	:	JINDAL/HINDALCO
CEILING	:	ARMSTRONG/SAINT GOBAIN/USG BORAL
ADHESSIVE	:	FEVICOL/PIDILITE
BLINDS	:	VISTA LEVLOR/MAC
FLUSH DOOR	:	GREENPLY/CENTURY/ARCHIDPLY BLOCK
BOARD & PLYWOOD	:	GREENPLY/CENTURY/ARCHIDPLY
LAMINATES	:	GREENPLY/CENTURY/ARCHIDPLY/MERINO
LOCKS	:	GODREJ/DOORSET/HAFELLE/ MIFA/ EBCO
HARDWARES	:	GODREJ/DOORSET/HAFELLE/ MIFA/ EBCO
CEMENT CONCRETE PIPES	:	INDIAN HUME PIPE/MM METAL & CO DOOR
CLOSER	:	GODREJ/DOORSET/HAFELLE/ MIFA/ EBCO
PVC DOOR	:	RAJASHREE
ALUMINIUM WINDOW	:	ALUCRAFT/ JINDAL
ALUMINIUM DOOR	:	ALUCRAFT / JINDAL
UPVC WINDOW	:	NCL/DUROPLAST
UPVC DOOR	:	NCL/DUROPLAST
STEEL SECTION	:	TATA/JINDAL/SAIL
ACP CLADDING	:	ALSTONE/ALUDECOR/ALSTRONG
PAVER BLOCK	:	TUFFSTONE/ MAA JATIYANI, Bhubaneswar
GALVANIUM SHEET	:	TATA/ JINDAL
WALL PAPER	:	MARSHALL

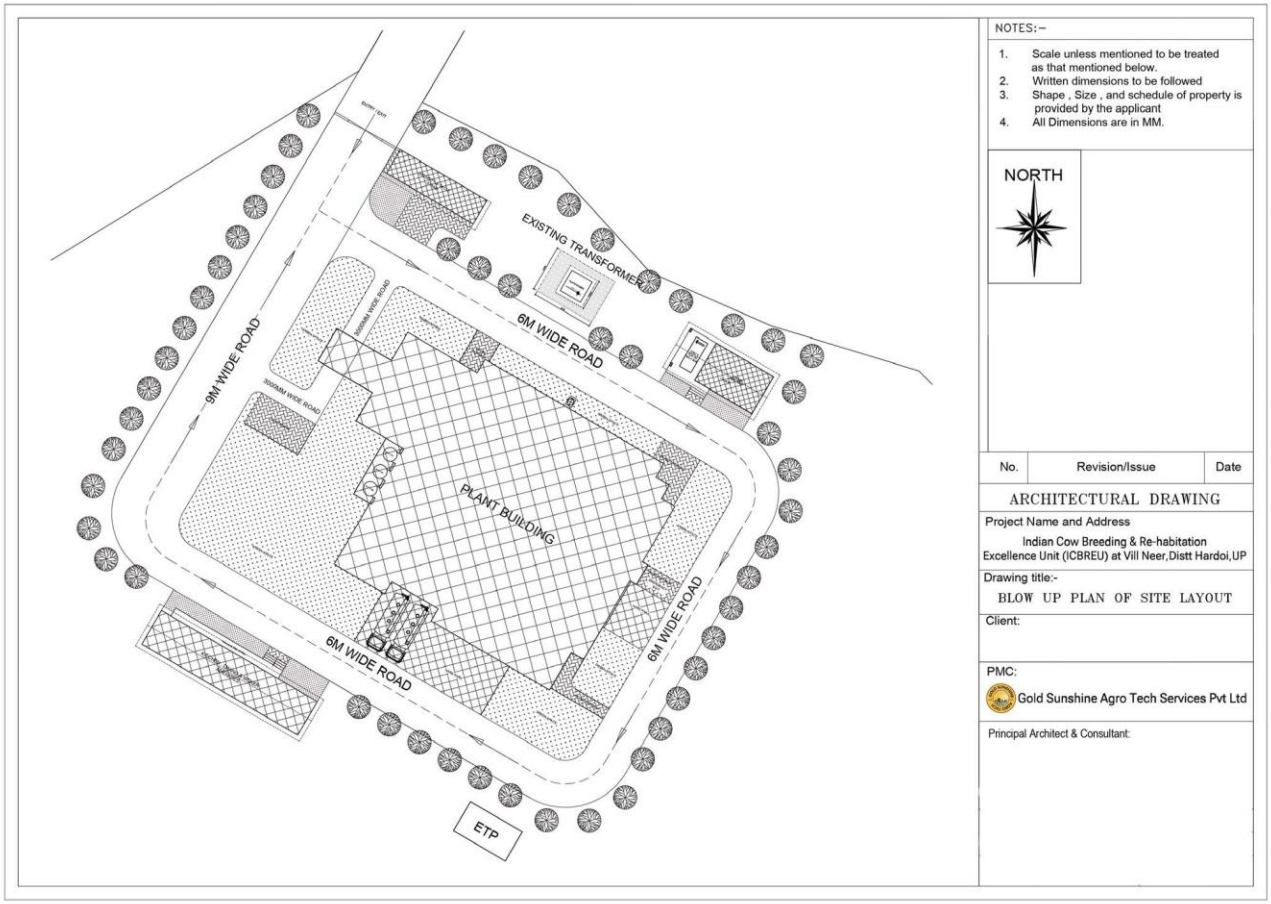
2. WATER SUPPLY & SANITATION WORKS:

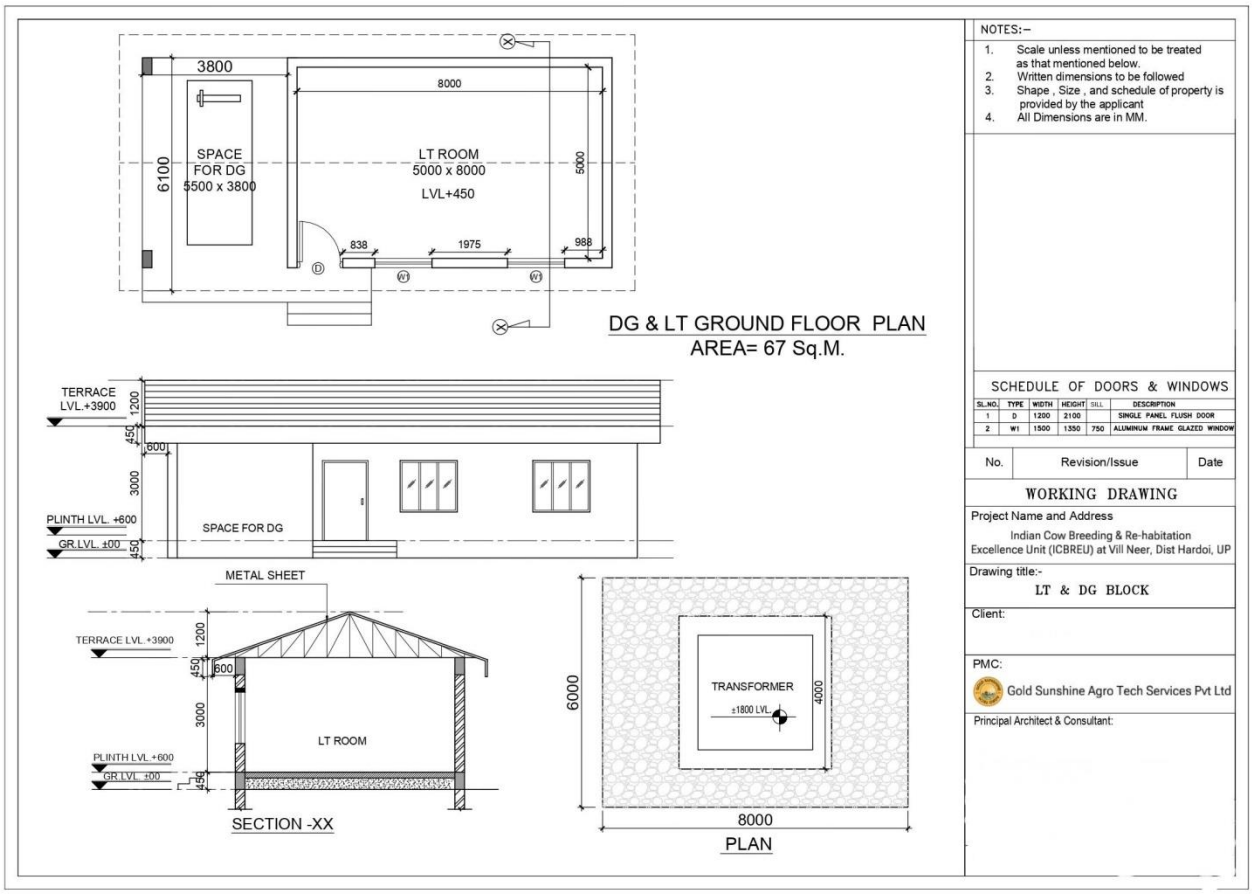
VITREOUS SANITARY WARE	:	HINDWARE/PARRYWARE/JAQUAR/KOHLER /ESSCO
BIB COCK & CP FITTINGS	:	HINDWARE/PARRYWARE/JAQUAR/KOHLER / ESSCO
CPVC PIPES & FITTINGS	:	ASTRAL/ASHRIBAD/SUPREME GI
PIPES	:	TATA/JINDAL
CI PIPES	:	KIRLOSKER/VENUS/SUSHILA
SWR PIPES	:	ASTRAL/ASHRIBAD/SUPREME
OVER HEAD TANK	:	SYNTEX
MIRRORS	:	SAINTGOBIN/ASAHI
FERRULES	:	LEADER/HIMSON
GATE VALVE/CHECK VALVE	:	LEADER/KIRTI
GI PIPE FITTINGS	:	KS BRAND/JINDAL/KIRTI
NAHANI TRAP	:	ASTRAL/ASHRIBAD/SUPREME
KITCHEN SINK	:	NIRALI
PVC PIPE	:	ASTRAL/ASHRIBAD/SUPREME

3. ELECTRICAL WORKS:

MS CONDUIT PIPE	:	AKG/POLYCAB
MS CONDUIT ACCESSORIES	:	AKG/POLYCAB
SWITCH/SOCKET/HOLDER	:	HAVELLS/ABB/LEGRAND/L&T PVC
INSULATED WIRES	:	HAVELLS/KEI/FINOLEX/POLYCAB PVC
INSULATED CABLES	:	HAVELLS/KEI/FINOLEX/POLYCAB
SWITCH GEARS/CHANGEOVER	:	SIEMENS/L&T/ABB/SCHENIDER/HAVELLS MCB/RCCB
	:	SIEMENS/L&T/ABB/SCHENIDER/HAVELLS LT
DISTRIBUTION BOARD	:	AUTORIZED PANEL MFG. OF L&T AND ABB LIGHT
FITTING & FIXTURE	:	HAVELLS/ FINOLEX/POLYCAB
CABIN/PEDESTAL FANS/ CEILING FANS	:	CROMPTON/USHA/ORIENT/HAVELLS
EXHAUST FAN	:	CROMPTON/USHA/ORIENT/HAVELLS
MODULAR SWITCH:		HAVELLS/ABB/LEGRAND/L&T
GI PIPES	:	TATA/JINDAL
AIR CIRCULATOR	:	CROMPTON/GEC
AIR CONDITIONER (PACKAGE & SPLIT)	:	BLUESTAR/CAREER/LG/VOLTAS

DRAWINGS


9M WIDE ROAD
EXISTING TRANSFORMER
6M WIDE ROAD
PLANT BUILDING
6M WIDE ROAD
6M WIDE ROAD
ETP
NOTES:–
1. Scale unless mentioned to be treated as that mentioned below.
2. Written dimensions to be followed
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.
NORTH
No.
Revision/Issue
Date
ARCHITECTURAL DRAWING
Project Name and Address
Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer,Distt Hardoi,UP
Drawing title:-
BLOW UP PLAN OF SITE LAYOUT
Client:
PMC:
Gold Sunshine Agro Tech Services Pvt Ltd
Principal Architect & Consultant: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FOR DG
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LT ROOM
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LVL+450
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W1
DG & LT GROUND FLOOR PLAN
AREA= 67 Sq.M.
TERRACE
LVL.+3900
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450
600
3000
PLINTH LVL. +600
GR.LVL. ±00
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LT ROOM
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SECTION -XX
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TRANSFORMER
±1800 LVL.
4000
8000
PLAN
NOTES:–
1. Scale unless mentioned to be treated as that mentioned below.
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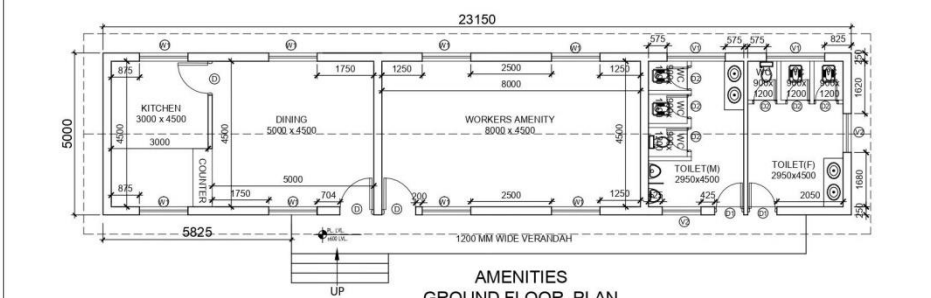
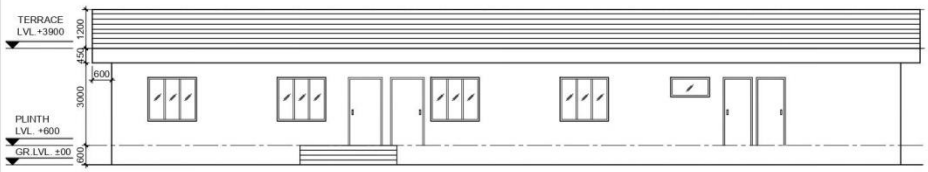
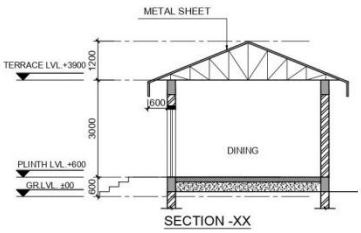
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.
SCHEDULE OF DOORS & WINDOWS
SL.NO. | TYPE | WIDTH | HEIGHT | SILL | DESCRIPTION
1 | D | 1200 | 2100 | | SINGLE PANEL FLUSH DOOR
2 | W1 | 1500 | 1350 | 750 | ALUMINUM FRAME GLAZED WINDOW
No. | Revision/Issue | Date
WORKING DRAWING
Project Name and Address
Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer, Dist Hardoi, UP
Drawing title:-
LT & DG BLOCK
Client:
PMC:
Gold Sunshine Agro Tech Services Pvt Ltd
Principal Architect & Consultant:



AMENITIES
GROUND FLOOR PLAN
AREA= 115 Sq.M.



ELEVATION



SECTION -XX

NOTES:–

1. Scale unless mentioned to be treated as that mentioned below.
2. Written dimensions to be followed
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.

SCHEDULE OF DOORS & WINDOWS

SL.NO.	TYPE	WIDTH	HEIGHT	SILL	DESCRIPTION
1	D	1050	2100		SINGLE PANEL FLUSH DOOR
2	D1	900	2100		SINGLE PANEL FLUSH DOOR
3	D2	900	2100		SINGLE PANEL PVC DOOR
4	W1	1500	1350	750	ALUMINUM FRAME GLAZED WINDOW
5	V1	1800	600	1500	ALUMINUM LOUVERED WINDOW
6	V2	1200	600	1500	ALUMINUM LOUVERED WINDOW

No.	Revision/Issue	Date

WORKING DRAWING

Project Name and Address

Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer, Dist Hardoi, UP

Drawing title:-

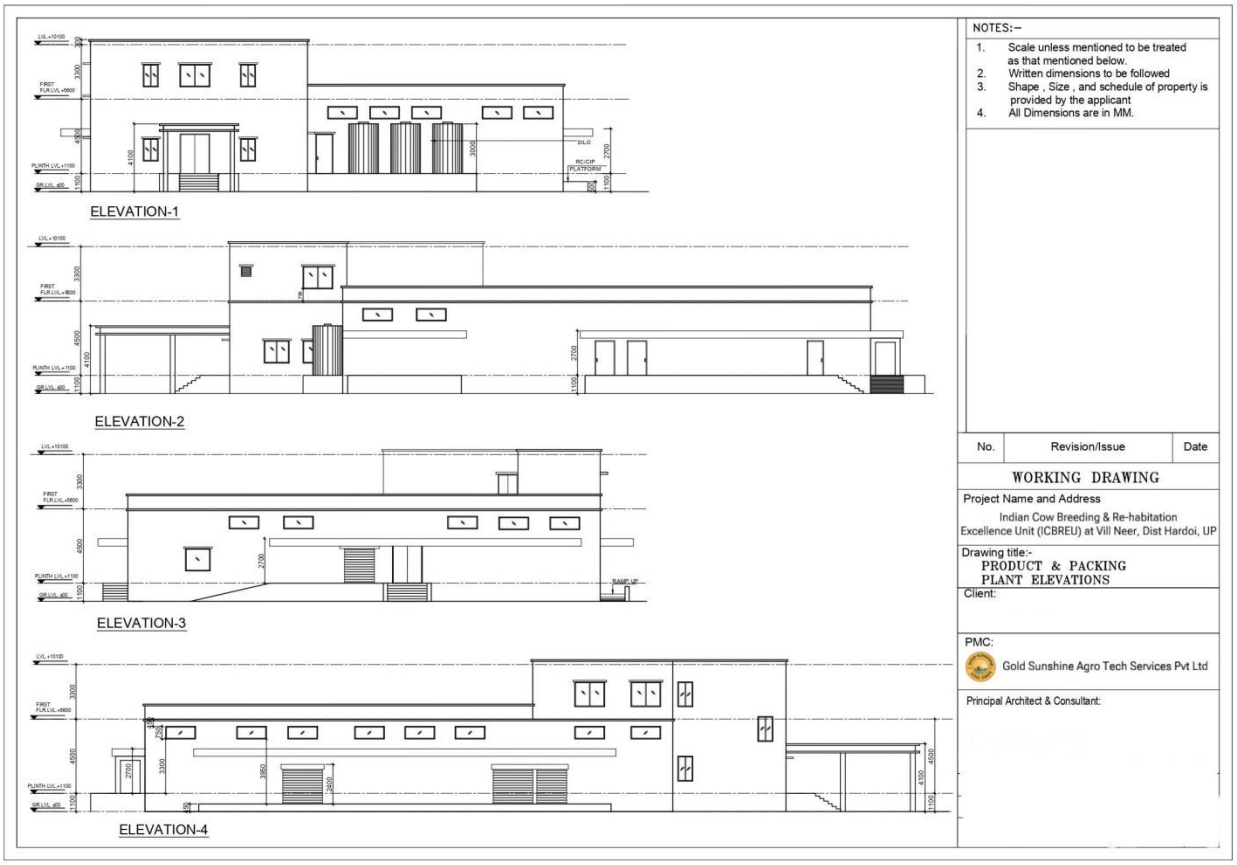
CANTEEN ,LABOUR SHED & TOILET BLOCK

Client:

PMC:

Gold Sunshine Agro Tech Services Pvt Ltd

Principal Architect & Consultant: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ELEVATION-2
ELEVATION-3
ELEVATION-4
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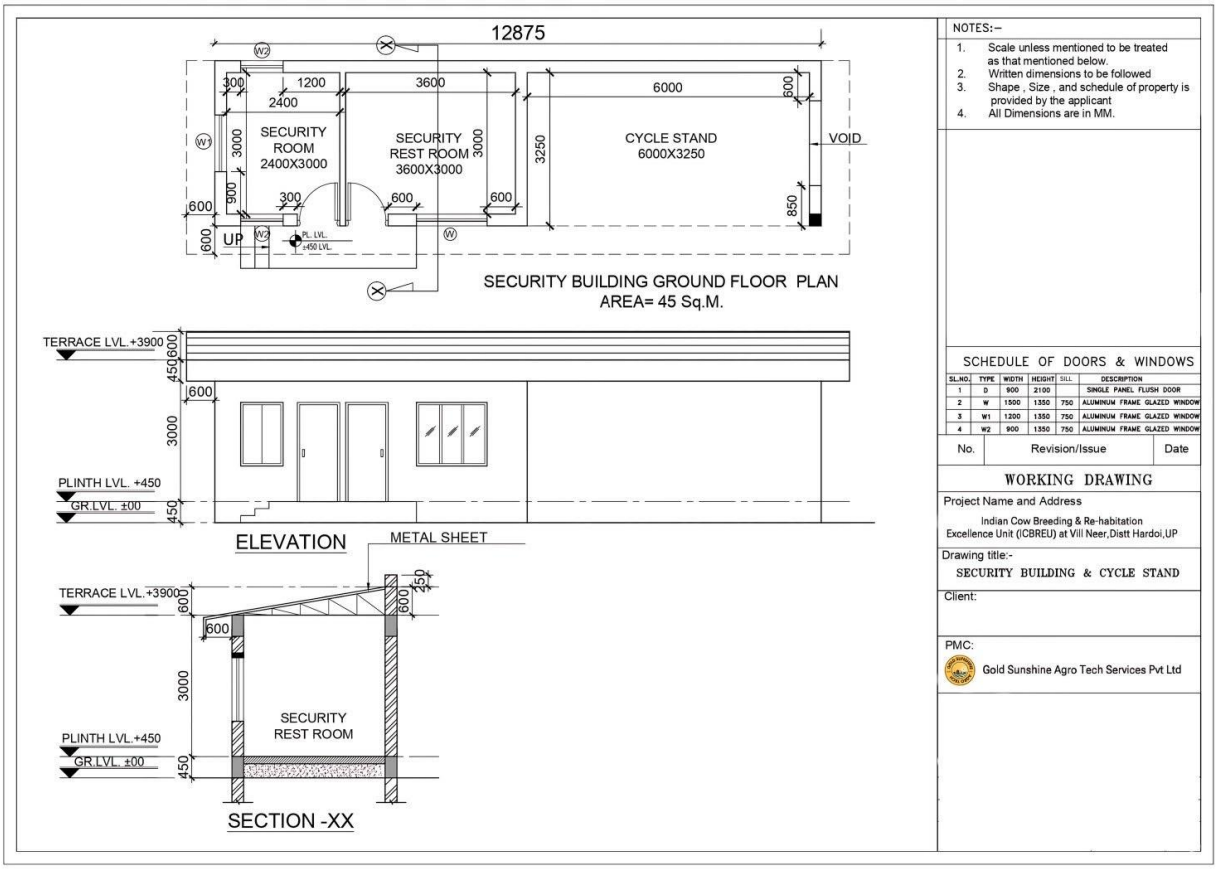
1. Scale unless mentioned to be treated as that mentioned below.
2. Written dimensions to be followed
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.
No.
Revision/Issue
Date
WORKING DRAWING
Project Name and Address
Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer, Dist Hardoi, UP
Drawing title:-
PRODUCT & PACKING PLANT ELEVATIONS
Client:
PMC:
Gold Sunshine Agro Tech Services Pvt Ltd
Principal Architect & Consultant:



NOTES:–

1. Scale unless mentioned to be treated as that mentioned below.
2. Written dimensions to be followed
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.

SCHEDULE OF DOORS & WINDOWS

SL.NO.	TYPE	WIDTH	HEIGHT	SILL	DESCRIPTION
1	D	900	2100		SINGLE PANEL FLUSH DOOR
2	W	1500	1350	750	ALUMINUM FRAME GLAZED WINDOW
3	W1	1200	1350	750	ALUMINUM FRAME GLAZED WINDOW
4	W2	900	1350	750	ALUMINUM FRAME GLAZED WINDOW

No.	Revision/Issue	Date

WORKING DRAWING

Project Name and Address

Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer,Distt Hardoi,UP

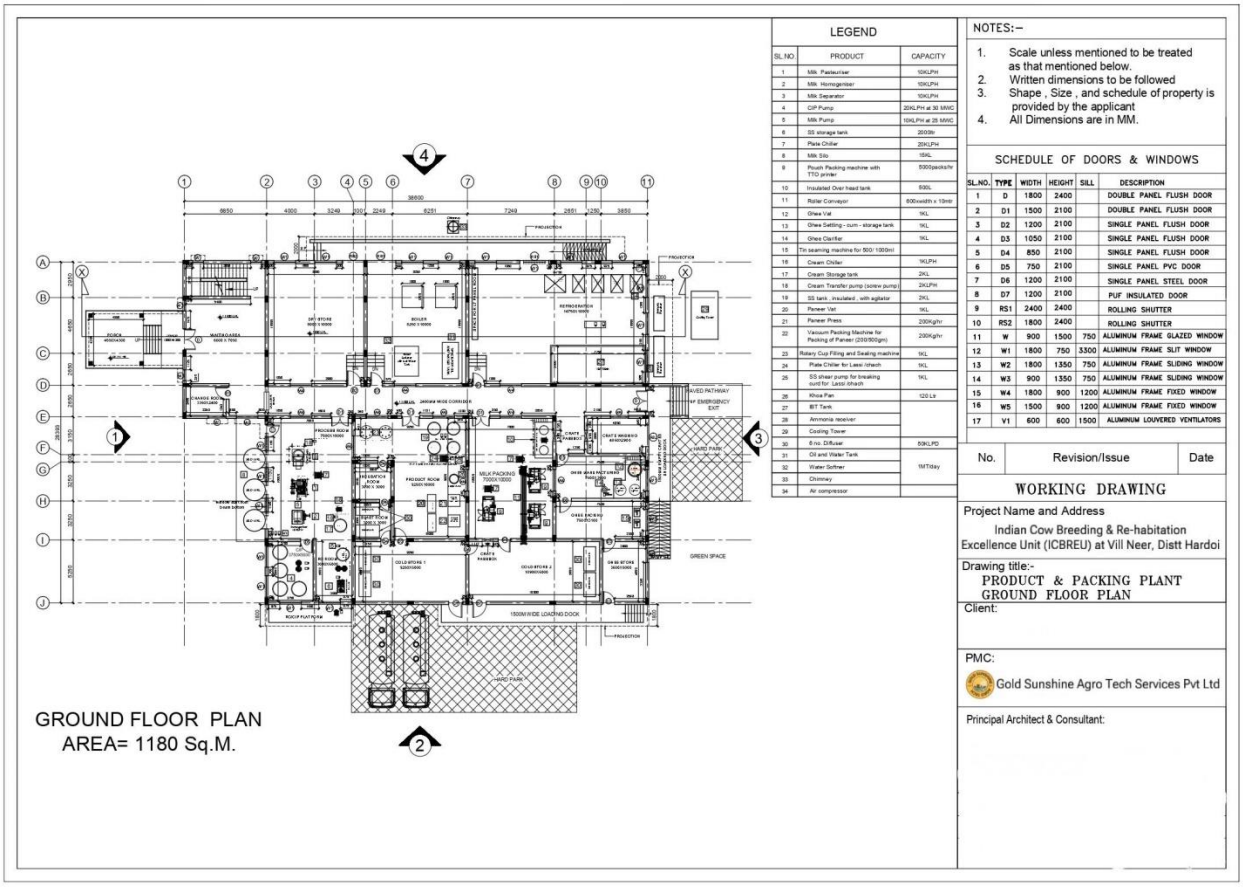
Drawing title:-

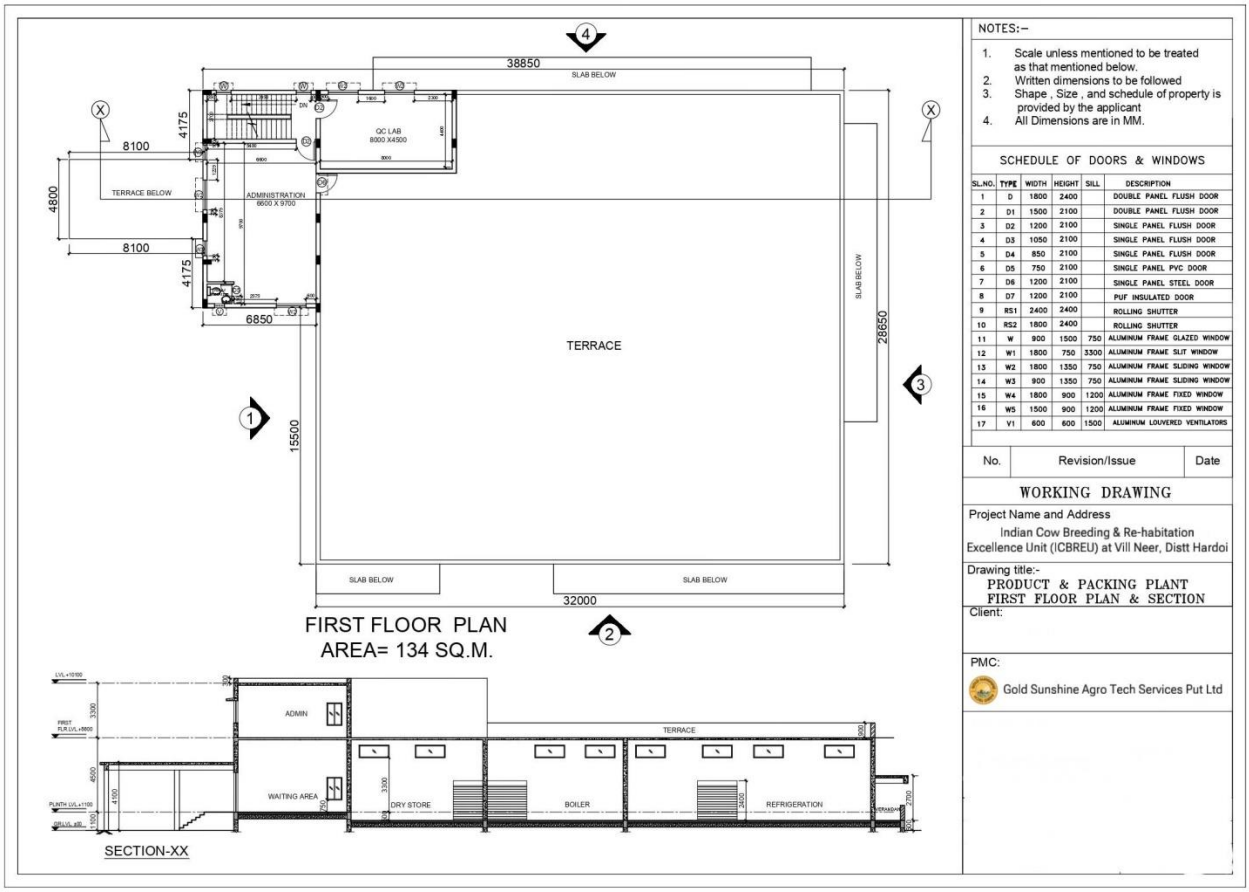
SECURITY BUILDING & CYCLE STAND

Client:

PMC:

Gold Sunshine Agro Tech Services Pvt Ltd


GROUND FLOOR PLAN
AREA= 1180 Sq.M.
LEGEND
SL.NO. PRODUCT CAPACITY
1 Milk Pasteuriser 10KLPH
2 Milk Homogeniser 10KLPH
3 Milk Separator 10KLPH
4 CIP Pump 20KLPH at 30 MWC
5 Milk Pump 10KLPH at 25 MWC
6 SS storage tank 2000ltr
7 Plate Chiller 20KLPH
8 Milk Silo 15KL
9 Pouch Packing machine with TTO printer 5000packs/hr
10 Insulated Over head tank 500L
11 Roller Conveyor 600mxwidth x 10mtr
12 Ghee Vat 1KL
13 Ghee Settling - cum - storage tank 1KL
14 Ghee Clarifier 1KL
15 Tin seaming machine for 500/ 1000ml
16 Cream Chiller 1KLPH
17 Cream Storage tank 2KL
18 Cream Transfer pump (screw pump) 2KLPH
19 SS tank , insulated , with agitator 2KL
20 Paneer Vat 1KL
21 Paneer Press 200Kg/hr
22 Vacuum Packing Machine for Packing of Paneer (200/500gm) 200Kg/hr
23 Rotary Cup Filling and Sealing machine 1KL
24 Plate Chiller for Lassi /chech 1KL
25 SS shear pump for breaking curd for Lassi /chach 1KL
26 Khoa Pan 120 Ltr
27 IBT Tank
28 Ammonia receiver
29 Cooling Tower
30 S no. Diffuser 50KLPD
31 Oil and Water Tank
32 Water Softner 1MT/day
33 Chimney
34 Air compressor
NOTES:–
1. Scale unless mentioned to be treated as that mentioned below.
2. Written dimensions to be followed
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.
SCHEDULE OF DOORS & WINDOWS
SL.NO. TYPE WIDTH HEIGHT SILL DESCRIPTION
1 D 1800 2400 DOUBLE PANEL FLUSH DOOR
2 D1 1500 2100 DOUBLE PANEL FLUSH DOOR
3 D2 1200 2100 SINGLE PANEL FLUSH DOOR
4 D3 1050 2100 SINGLE PANEL FLUSH DOOR
5 D4 850 2100 SINGLE PANEL FLUSH DOOR
6 D5 750 2100 SINGLE PANEL PVC DOOR
7 D6 1200 2100 SINGLE PANEL STEEL DOOR
8 D7 1200 2100 PUF INSULATED DOOR
9 RS1 2400 2400 ROLLING SHUTTER
10 RS2 1800 2400 ROLLING SHUTTER
11 W 900 1500 750 ALUMINUM FRAME GLAZED WINDOW
12 W1 1800 750 3300 ALUMINUM FRAME SLIT WINDOW
13 W2 1800 1350 750 ALUMINUM FRAME SLIDING WINDOW
14 W3 900 1350 750 ALUMINUM FRAME SLIDING WINDOW
15 W4 1800 900 1200 ALUMINUM FRAME FIXED WINDOW
16 W5 1500 900 1200 ALUMINUM FRAME FIXED WINDOW
17 V1 600 600 1500 ALUMINUM LOUVERED VENTILATORS
No. Revision/Issue Date
WORKING DRAWING
Project Name and Address
Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer, Distt Hardoi
Drawing title:-
PRODUCT & PACKING PLANT GROUND FLOOR PLAN
Client:
PMC:
Gold Sunshine Agro Tech Services Pvt Ltd
Principal Architect & Consultant:



NOTES:–

1. Scale unless mentioned to be treated as that mentioned below.
2. Written dimensions to be followed
3. Shape , Size , and schedule of property is provided by the applicant
4. All Dimensions are in MM.

SCHEDULE OF DOORS & WINDOWS

SL.NO.	TYPE	WIDTH	HEIGHT	SILL	DESCRIPTION
1	D	1800	2400		DOUBLE PANEL FLUSH DOOR
2	D1	1500	2100		DOUBLE PANEL FLUSH DOOR
3	D2	1200	2100		SINGLE PANEL FLUSH DOOR
4	D3	1050	2100		SINGLE PANEL FLUSH DOOR
5	D4	850	2100		SINGLE PANEL FLUSH DOOR
6	D5	750	2100		SINGLE PANEL PVC DOOR
7	D6	1200	2100		SINGLE PANEL STEEL DOOR
8	D7	1200	2100		PUF INSULATED DOOR
9	RS1	2400	2400		ROLLING SHUTTER
10	RS2	1800	2400		ROLLING SHUTTER
11	W	900	1500	750	ALUMINUM FRAME GLAZED WINDOW
12	W1	1800	750	3300	ALUMINUM FRAME SLIT WINDOW
13	W2	1800	1350	750	ALUMINUM FRAME SLIDING WINDOW
14	W3	900	1350	750	ALUMINUM FRAME SLIDING WINDOW
15	W4	1800	900	1200	ALUMINUM FRAME FIXED WINDOW
16	W5	1500	900	1200	ALUMINUM FRAME FIXED WINDOW
17	V1	600	600	1500	ALUMINUM LOUVERED VENTILATORS

No.	Revision/Issue	Date

WORKING DRAWING

Project Name and Address
Indian Cow Breeding & Re-habitation Excellence Unit (ICBREU) at Vill Neer, Distt Hardoi

Drawing title:-
PRODUCT & PACKING PLANT
FIRST FLOOR PLAN & SECTION

Client:

PMC:
Gold Sunshine Agro Tech Services Put Ltd