MAZAGON DOCK SHIPBUILDERS LIMITED
(Formerly known as Mazagon Dock Ltd.)
CIN : U35100MH1934GOI002079
(A Government of India Undertaking)
Shipbuilders to the Nation
Dockyard Road, Mazagon,
Mumbai 400 010.
INDIA

Technical Specification

with

Preferred Make

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CIVIL & INTERIOR WORKS TECHNICAL SPECIFICATIONS

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I CIVIL & INTERIOR WORKS TECHNICAL SPECIFICATIONS

GENERAL

i. The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein & 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 & these shall be read in conjunction with the description of item in schedule of quantities & drawings. The work also includes all minor details of construction which are obviously & fairly intended & 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 Latest codes & standards published by the Indian Standard Institution & all other standard which may be published by them before the date of receipt of tenders, shall govern in all respects of dosing workmanship quality & propitious of materials & 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 to or revisions thereof, if any, up to the date of receipt of tenders.

iv. In case there is no I.S.I specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, & requirements of the Engineers-in-Charge. Wherever any reference to any Indian standard specification occurs in the documents relating to this contract, the same shall be inclusive of all amendment issued there to or revisions thereof, if any, up to the date of receipt of tenders. Materials shall be conforming to Indian Standard / BSI /ASTM Latest codes as applicable.

v. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of MDL /Municipal Corporation 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, fitting etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineers-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 allotted 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 & nothing extra whatsoever shall be payable to the contractor for the test.

x. The contractor shall clear the site thoroughly of all scaffolding materials & rubbish etc. left out of his work & dress the site around the building to the satisfactions of the EIC & his decision in writing shall be final & binding on all concerned.

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 cost be adjusted from the outstanding security deposit, as per the terms and conditions of the contract for the work.

xii. MDL concerned Engineering Division, shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and its decision in writing shall be final and binding on all concerned.

xiii. In case any different or discrepancy between the specification & the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specification & drawing, the specification shall take precedence. Any discrepancy shall be brought to the notice of Engineer In Charge, resolved mutually prior to implementation of that work. <u>All works shall be carried out as per the Latest working drawings, specifications, Indian standard codes, Central Public Work Department Specifications (VOL. 1 &2) & work done to the satisfaction of Engineer In Charge.</u>

II – LIST OF INDIAN STANDARDS:

Following are the various pertinent Indian Standards, relevant to buildings work :

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

I. S. CODE NO.	**S U B J E C T**
A. CIVIL WORKS	
1. CARRIAGE OF MATERIALS	
4082-1996	Recommendations on stacking & storage of construction materials and components at site.
2. EARTH WORK	
1200 Pt. I-1992	Method of measurement of Earth work.
4081-2013	Safety code for Blasting and related drilling operations.
6313 (Part 2) 2013	Anti Termite Measures in Buildings Part – 2 Pre-constructional chemical treatment .
3. MORTAR	
196-1966	Atmospheric conditions for testing (Reaffirmed - 2006)
269-2015	Ordinary Portland cement Specification. (Sixth Revision)
383-2016	Coarse and fine aggregates from natural sources for concrete.
455-2015	Portland slag cement
650-1991	Standard sand for testing of cement
712-1984	Building Limes
1489-2015	Portland pozzolana cement Fly ash based
1514-1990	Methods of sampling & Test for Quick Lime & Hydrated Lime. (Reaffirmed - 2010)
1542-1992	Sand for Plastering(Reaffirmed – 2009)
1727-1967	Methods of tests for pozzolanic materials(Reaffirmed – 2008)
2250-1981	Code of practice for preparation and use of masonry mortar. (Reaffirm-2010)
2386-1963	Methods of Test for Aggregates for Concrete
2386 Pt.I-1963	Particle size and shape(Reaffirm- 2016)

2386 Pt. II-1963	Estimation of deleterious materials and organic impurities(Reaffirm-2016)
I. S. CODE NO.	**S U B J E C T**
2386 Pt.III-1963	Specific gravity, density, voids, absorption and bulking(Reaffirm- 2016)
2686-1977	Cinder as fine aggregate for use of Lime Concrete. (Reaffirmed – 2009)
3025-1987	Methods of sampling & test (Physical & Chemical) for water & waste water (Reaffirmed-2014)
3068-1986	Broken brick (burnt clay) coarse aggregate for use in lime concrete (II-R.) (Reaffirmed – 2009)
3182-1986	Broken brick (Burnt clay) fine aggregate for use in lime mortar.) (Reaffirmed – 2009)
3812-2013 (Part1)	Pulverized Fuel Ash - For Use as Pozzolana in Cement, Cement Mortar and Concrete
4031-1996	Methods of physical tests for hydraulic cement (Reaffirmed – 2016)
4032-1985.	Method of chemical analysis of hydraulic cement (Reaffirmed - 2009)
4098-1983	Lime pozzolana mixture (Reaffirmed - 2009)
6932 (Pt.I to X)	Methods of Test for Building Lime
6932 (Pt.I)-1973	Determination of insoluble residue, loss of ignition, silicon-dioxide, ferric & Alum. Oxide,
6932 (Pt.II)-1973	Determination of carbon dioxide content
6932 (Pt.III)-1973	Determination of residue on slaking of quick lime.
6932 (Pt.IV)-1973	Determination of fineness of hydrated lime
6932 (Pt.V)-1973	Determination of unhydrated oxide
6932 (Pt.VI)-1973	Determination of volume yield of quick lime
6932 (Pt.VII)-1 973	Determination of compressive and transverse strength.
6932(Pt.VIII)-1 973	Determination of workability
6932 (Pt.IX)-1973	Determination of soundness
6932 (Pt.X)-1973	Determination of popping and pitting of hydrated Lime.
4. CONCRETE WORK	

383	Coarse and fine aggregate from natural sources for concrete (Reaffirm - 2016)
456-2000	Code of practice for plain and reinforced concrete(Reaffirm - 2016)
516-1959	Method of test for strength of concrete (Reaffirmed in 2013)
I. S. CODE NO.	**S U B J E C T**
1199-1959	Method of sampling and analysis of concrete(Reaffirmed in 2013)
1200 (Pt.II)-1974	Methods of measurements of cement concrete work. (Reaffirm - 2007)
1322-1993	Bitumen felts for water proofing and damp proofing. (Reaffirm - 2008)
1661- 1972	Code of practice for application of cement lime plaster finishes.(Reaffirm- 2016)
2386-1963 (Pt.1 to 8)	Methods of test for aggregate for concrete.(Reaffirm- 2016)
2386 (Pt.I)-1963	Test for particle size and shape.(Reaffirm- 2016)
2386 (Pt.II)-1963	Test for estimation of deleterious materials and organic impurities.(Reaffirm- 2016)
2386 (Pt.III)-1 963	Test for specific gravity, density, voids, absorption and bulking.(Reaffirm- 2016)
2386 (Pt.IV)-1963	Mechanical properties.(Reaffirm- 2016)
2645-2003	Specification for integral water proofing compounds (Reaffirm- 2017)
2686-1977	Specification for cinder aggregate for use in lime concrete. (Reaffirm - 2009)
3812-2013 Part2	Fly Ash using as admixtures in cement ,mortar , concrete.
7861-1975 (Pt.I)	Hot weather concreting. .(Reaffirmed -2011)
7861-1981 (Pt.II)	Cold weather concreting. .(Reaffirmed -2011)
9103-1999	Admixture for concrete. .(Reaffirmed -2013)
5. R.C.C. WORK	
432-1982 Part 1	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement: Part 1 Mild Steel and Medium Tensile Steel Bars.(Reaffirmed -2015)

432-1982 Part II	Mild Steel and Medium Tensile Steel Bars and Hard-Drawn Steel Wire for Concrete Reinforcement: Part 2 Hard-Drawn Steel Wires.(Reaffirmed -2009)
456-2000	Code of practice for plain and reinforced concrete.(Reaffirmed -2016)
457-1957	COP for general const. of plain & reinforced concrete for dams & other massive structure. .(Reaffirmed -2009)
516-1959	Methods of test for strength of concrete.(Reaffirmed -2013)
1161-2014	Specifications for steel tubes for structural purposes
I. S. CODE NO.	**S U B J E C T**
1199-1959	Methods of sampling and analysis of concrete. (Reaffirmed - 2013)
1200 (Pt.II) - 1974	Method of measurement of cement concrete work (Reaffirmed -2007)
1200(Pt.V) - 2007	Method of measurement of form work. (Reaffirmed - 2013)
1343-2012	Code of practice for pre-stressed concrete.
1566-1982	Hard drawn steel wire fabric for concrete reinforcements (Reff. 2009)
1785-1983 (Part-I& II)	Specifications for plain hard-drawn steel wire for prestressed concrete: Part 1 Cold drawn stress-relieved wire (Reaffirmed - 2013)
1786-2008	High strength deformed steel bars and wires for concrete reinforcement (Reaffirmed - 2013)
2090-1983	Specifications for high tensile steel bars used in prestressed concrete. (Reaffirmed – 2009)
2204-1962	Code of practice for construction of reinforced concrete shell roof. (Reaffirmed - 2010)
2210-1988	Criteria for the design of shell structure and folded plates (Reaffirmed - 2008)
2502-1963	COP for bending and fixing of bars for concrete reinforcement. (Reaffirmed - 2008)
2750-1964	Specifications for steel scaffoldings(Reaffirmed - 2010)
2751-1979 (Reaf-2008)	COP for welding of mild steel bars & Deformed bars for reinforced concrete construction.
2911-(Pt.I)-SEC 1 -2010	Code of practice for design & Constn. of pile foundations- Driven Cast In-situ Concrete Piles
2911(Pt.I)-SEC 2 -2010	Design & construction of Pile Foundations - Bored precast concrete piles.
2911 (Pt.III)-1980	Under reamed pile foundations(Reaffirmed – 2010)

2911 (Pt.IV)-2013	Load test on Piles
3201-1988	Criteria for design and construction of precast trusses & Purlins. (Reaffirmed - 2009)
3370.(Part I)-2009	Code of practice for concrete structures for storage of liquids-General requirements.
3370.(Part II)-2009	Code of practice for concrete structures for storage of liquids-Reinforced concrete structures
3414-1968	Code of practice for design and installation of joints in buildings. (Reaffirmed - 2010)
I. S. CODE NO.	**S U B J E C T**
3558-1983(Reaf-	Code of practice for use of immersion vibrators for consolidating concrete
3696 (Pt.I & II)	I-1987: Safety code of scaffolds; II-1991: Safety code of ladders
3935-1966	Code of practice for composite construction. (Reaffirmed – 2008)
4014-1967 (Pt. I & II)	COP for steel tubular scaffolding (I: Definition/Material; II: Safety provision) (Reaffirmed 2010)
4926-2003	Code of practice for Ready Mix Concrete(Reaffirmed – 2017)
4990-2011	Specifications for plywood for concrete shuttering work.
10262-2009	Guidelines for concrete mix design proportioning (Reaffirmed - 2017)
6. EQUIPMENTS	
460-1985 (Pt-I,II& III)	Specification for test sieves. (Reaffirmed - 1998)
1791-1985	Specification for batch type concrete mixer. (Reaffirmed – 2015)
2430-1986	Methods for sampling of Aggregates for concrete. (Reaffirmed – 2009)
2505-1992	General requirement for concrete vibrators, immersion type(Reaffirmed – 2008)
2506-1985	General requirements for screed board concrete vibrators(Reaffirmed – 2016)
2514-1963	Specification for concrete vibrating tables. (Reaffirmed - 2017)
2722-1964(Reaf-	Specification for portable swing weighbatchers for concrete (single and double bucket type).
2750-1964	Specification for steel scaffolding. (Reaffirmed – 2010)
7. BRICK WORK:	
1077-1992	Common burnt clay building bricks(Reaffirmed – 2011)

1200 (Pt.III)-1976	Method of measurements of brick work. (Reaffirmed - 2007)
2116-1980	Sand for masonry mortars. (Reaffirmed - 2007)
2212-1991	Code of practice for brick work(Reaffirmed - 2009)
2250-1981	Code of practice for preparation & use of masonry mortar. (Reaffirmed - 2010)
3495 (Pt.ItoIV)-1992	Methods of tests of burnt clay building bricks: Part 1 Determination of compressive strength Part 2 Determination of water absorption Part 3 Determination of efflorescence Part 4 Determination of warpage(Reaffirmed - 2011)
5454-1978	Method for sampling of clay building bricks. (Reaffirmed - 2010)
I. S. CODE NO.	**S U B J E C T**
2185 (Part 3) 1984	Auto claved cellular (Areated) Concrete Blocks. (Reaffirmed - 2010)
8. STONE WORK:	
1121 (Pt.I)-2013	Methods of test for determination of strength properties of natural building stones: Part I Compressive strength
1122-1974	Method of test for determination of true specific gravity of natural building stones
1123-1975	Methods for identification of natural building stones(Reaffirmed – 2008)
1124-1974	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones(Reaffirmed - 2013)
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	Recommendation of dressing of natural building stones (Reaffirmed - 2013)
1200 (Pt.IV)-1976	Method of measurement of stone masonry. (Reaffirmed - 2007)
1597. (Pt.I)-1992	Code of practice for construction of Rubble stone masonry. (Reaffirmed -2011)
1597 (Pt.II)-1992	Code of practice for construction of ashlar masonry (Reaffirmed - 2011)
1805-1973	Glossary of Terms relating to stone Quarrying and dressing. Reaffirmed - 2008)
4101 (Pt.I)-1967	Stone facing. (Reaffirmed - 2010)
9. MARBLE WORK:	

1122-1974	Methods for determination of specific gravity and porosity of natural building stones (Reaffirmed - 2008)
1124-1974	Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones (Reaffirmed - 2013)
1130-1969	Marble (blocks, slabs and tiles) (Reaffirmed - 2008)
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(Reaffirmed - 2012)
206-2010	Tee and strap hinges(Reaffirmed - 2012)
207-1964	Gate and shutter hooks and eyes. (Reaffirmed - 2011)
208-1996	Door handles
I. S. CODE NO.	**S U B J E C T**
281-2009	Mild steel sliding door bolts for use with padlocks
287-1993(Reaf-2008)	Recommendation for maximum permissible moisture contents of timber used for Different purposes.
303-1989	Plywood for general purpose (Reaffirmed - 2013)
362-1991	Parliament hinges(Reaffirmed - 2010)
363-1993	Hasps and staples(Reaffirmed - 2008)
364-1993	Fanlight catch(Reaffirmed - 2008)
401-2001	Code of practice for preservation of timber(Reaffirmed - 2011)
419 - 1967	Putty for use on window frame (Reaffirmed - 2009)
451-1999	Technical supply condition for wood screws(Reaffirmed - 2010)
452-1973	Door springs, rat-tail type (Reaffirmed 2010)
453-1993	Double acting spring hinges. (Reaffirmed – 2008)
723-1972	Steel counter sunk head wire nails. (Reaffirmed - 2011)
729.1979	Drawer locks, cup board locks, and box locks (Reaffirmed 2012)
848-2006	Synthetic resin adhesive for plywood (phenolic and aminoplastic). (Reaffirmed - 2011)
851-1978	Synthetic resin adhesive for construction work (Non-structural) in wood (Reaffirmed 2009)
852-1994	Specifications for animal glue for general wood working purposes. (Reaffirmed 2009)

1003-1994	Timber panelled and glazed shutters
1003(Pt.I)-2003	Door shutters . (Reaffirmed – 2008)
1003 (Pt.II)-1994	Window and ventilator shutters (Reaffirmed - 2011)
1019-1974	Rim latches. (Reaffirmed - 2012)
1141-1993	Code of practice for seasoning of timber (Reaffirmed 2009)
1200	Method of measurement of Building and Civil Engineering works
1200 (Pt.XIV)-1984	Glazing. (Reaffirmed - 2007)
1200 (Pt.XXI)-1973	Wood work and joinery. (Reaffirmed - 2007)
1322-1993	Bitumen felts for water proofing and damp proofing. (Reaffirmed – 2008)
1328-1996	Veneered decorative plywood(Reaffirmed - 2011)
I. S. CODE NO.	**S U B J E C T**
1341-1992	Steel Butt hinges (Reaffirmed - 2012)
1378-1987	Oxidized copper finishes. (Reaffirmed - 2016)
1568-1970	Wire cloth for general purposes. (Reaffirmed - 2013)
1658-2006	Fiber hard board. (Reaffirmed - 2011)
1659-2004	Block boards(Reaffirmed 2009)
1823-1980	Floor door stoppers. (Reaffirmed - 2012)
1868-1996	Anodic coating on Aluminium & its alloy (II Rev.) (Reaffirmed 2016)
875- 1987 Part1	Dead loads –Unit weight of bldg. & stored materials(Reaffirmed – 2008)
2191-1983	Wooden flush door shutter (cellular and hollow core type). (Reaffirmed - 2011)
1837 - 1966	Fan light pivots (Reaffirmed 2010)
2095-2011	Plain Gypsum Plaster Boards
3828 - 1966	Ventilator chains (Reaf. 2010)
4835 - 1979	Polyvinyl acatete dispssion base adhasive for wood (2009)
2191 (Pt.I)-1983	Plywood face panels. (Reaffirmed - 2011)
2191 (Pt.II)-1983	Particle board face panels and hard board face panels. (Reaffirmed-1991)
2202-1999	Wooden flush door shutters (solid core type)

2202 (Pt.I)-1999	Plywood face panels for wooden flush door shutters
2202 (Pt.II)-1983	Particle board face panels for wooden flush door shutters. (Reaffirmed - 1991)
2209(Pt.I)-1976	Mortise locks (vertical type) (Reaffirmed 1992)
2380-1981	Method of test for wood particle board and boards from lignocellulosic materials (Reaf.1993)
2681-1993	Non ferrous metal sliding door bolts(aldrop) for use with pad locks
2835-1987	Flat transparent sheet glass (3rd Revision). (Reaffirmed - 1992)
3087-1985	Wood particle boards (medium density) for general purpose (1990)
3097-2006	Veneered particle boards (1st Revision).
3400 (Part I)-1987	Method of test for vulcanized rubbers (1991)
3400-(Pt.II)-2003	Hardness (1981)
I. S. CODE NO.	**S U B J E C T**
3400-(Pt.IV)-1987	Accelerated aging (1993)
3400 (Pt.IX)-2003	Relative density and density. (Reaffirmed - 1990)
3564-1995	Door closers (Hydraulically regulated)
3618-1966	Phosphate treatment of iron and steel for protection against corrosion. (Reaffirmed - 1991)
3813-1967	'C' hooks for use with swivels (1992)
3818-1992	Continuous (Piano) hinges
3847-1992	Mortise night latches
4020-1998 (1 to 16)	Methods of tests for wooden flush Doors (Type tests)
4021-1995	Timber door, window and ventilator frames
4827-1983	Electroplated coating of nickel and chromium on copper and copper alloys
4948-2002	Welded steel wire fabric for general use. (Reaffirmed - 1992)
4992-1975	Door Handles for mortise locks (vertical type). (Reaffirmed - 1990)
51 87-1972	Flush bolts (1990)
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)
71 96-1974	Hold fasts (1992)
71 97-1974	Double action floor springs (without oil check) for heavy doors
7534-1985	Sliding loacking bolt for use with padlocks. (Reaffirmed – 1991)
8756 - 1978	Mortice bell catches for use in wooden almirah (1992)
14856-2000	Glass fibre reinforced plastic (GRP) panel type door shutters for internal use – Specifications
11. STEEL WORK	
63-1978	Whiting for paints. (Reaffirmed - 1994)
198-1978	Varnish, gold size. (Reaffirmed - 1991)
12406 - 1988	Medium density fibre board for general purpose - (1992)
I. S. CODE NO.	**SUBJECT**
277-2003	Specification for galvanised steel sheets (plain and corrugated)
278-1978	Galvanised steel barbed wire for fencing. (Reaffirmed - 1991)
800-2007	Code of practice for use of structural steel in general building construction(Reaffirmed - 2013)
806-1968	Code of practice for use of steel tube in general building construction
813-1986	Scheme of symbols for welding. (Reaffirmed – 2008).
814-2004	Covered electrodes for metal arc welding of structural steel (Reaffirmed 2010)
814 (Pt-I)	For welding products other than sheets. *
814 (Pt-II)	For welding sheets. *
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.
1038-1983	Steel doors, windows and ventilators
1081-1960(Reaf-2011)	COP for fixing & glazing of metal (steel & aluminium) doors, windows & ventilators

1148-1982(Reaf-92)	Hot rolled steel rivet bars (upto 40 mm diameters)for structural purposes (Reaffirmed 2001)
1161-1998	Steel tubes for structural purposes
1182-1 983(Reaf-00)	Recommended practice for radiographic examination of fusion welded butt joints in steel plates.
1200 (Pt-VIII)-1993	Method of measurements of steel work and iron works
1363-1992 (Pt. 1- 3)	Hexagon bolts, nuts & lock nuts (dia. 6 to 39 mm) & black hexagon screws (dia. 6 to 24 mm).(Reaf-98)
1599-1 985(Reaf-9 1)	Method for bend test for steel products other than sheet, strip, wire & tube (reaffirmed 1996).
1608-1995	Method for tensile testing of steel products (Reaffirmed 2001)
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	Structural steel (fusion welding quality). (Reaffirmed – 2016)
4351-2003	Steel door frames. (Reaffirmed – 1991)
4736-1986	Hot-dip zinc coatings on steel tubes. (Reaffirmed – 2001)
6248-1979	Metal rolling shutters and rolling grills (Reaffirmed – 2011)
I. S. CODE NO.	**S U B J E C T**
7452-1990	Hot rolled steel sections for doors, windows & ventilators.
12. FLOORING:	
210-2009	Grey iron casting (Reaffirmed 1999)
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 – 2008)
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 (Pt.XI)-1977	Method of measurements of pavings and floor finishes.

1237-2012	Cement concrete flooring tiles. (Reaffirmed – 2016)
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
3400-1 987 (Part 1 to 22)	Method of Test of vulcanized rubbers. (Reaffirmed – 2003)
3400 (Pt.II)-2003	Hardness
3400 (Pt.X)-1977	Compression set at constant strain. (Reaffirmed – 2003)
3462-1986	Flexible P.V.C. Flooring. (Reaffirmed – 1991)
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 – 2007)
9197-1979	Specifications for epoxy resin, hardeners and epoxy resin compositions for floor topping (Reaffirmed – 2016)
13. ROOFING:	
73-1 992	Paving Bitumen (Reaffirmed 1998)
I. S. CODE NO.	**SUBJECT**
277-2003	Galvanised steel sheets (plain and corrugated)
I. S. CODE NO.	**SUBJECT**
458-2003	Concrete pipes (with and without reinforcement)
459-1992	Unreinforced corrugated and semicorrugated asbestos cement sheets
651-2007	Salt glazed stone ware pipes and fittings
702-1988	Industrial Bitumen
1199-1959	Method of Sampling & Analysis of concrete. (Reaffirmed - 1991)
1200 (Pt.IX)-1973	Method of measurements of roof covering (including cladding)
1200 (Pt.X)-1973	Method of measurements of ceiling and lining

13607 - 1992	Ready Mixed Paint, Finishing, General Purposes, Synthetic (Reaffirmed 2009)
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 I-III)	Asbestos cement building pipes, gutters and fittings (Spigot and socket types)
1834-1984	Specification for hot applied sealing compounds for joints in concrete. (Reaffirmed - 2010)
1838-(Pt.I & II)-1983	Preformed filler for expansion joints in concrete- non-extruding and resilient type Bitumen impregnated fiber). (Reaffirmed - 2015)
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-(Pt.I)-1999	Code of practice for laying of corrugated asbestos cement sheets. (Reaffirmed – 1991)
3007-(Pt.II)-1965	Code of practice for laying of semi corrugated asbestos cement sheet. (Reaffirmed - 1991)
3348-1965	Fiber insulation boards. (Reaffirmed - 1990)
3607-1979	Magnesite for chemical Industry. (Reaffirmed – 2003)
71 93-1994	Specifications for glass fiber base coal tar Pitch & Bitumen felts.
8183-1993	Bonded mineral wool. (Reaffirmed 2004)
14. FINISHING	
75-1973	Linseed oil, raw and refined. (Reaffirmed – 2010)
77-1976	Linseed oil, boiled, for paints. (Reaffirmed - 2009)
104-1979	Specification for ready mixed paint, brushing, zinc chrome, priming. (Reaffirmed - 1999)
NO.I.S. CODE	**S U B J E C T**
133-1993	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

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)
290-1961	Coal tar black paint. (Reaffirmed – 1996)
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)
427-1965	Distemper, dry, colour as required. (Reaffirmed – 1999)
428-2000	Washable distember
524-1983	Varnish, finishing, exterior, synthetic. (Reaffirmed – 2000)
525-1968	Varnish, finishing, exterior and general purposes. (Reaffirmed – 2001)
533-1998	Gum spirit of turpentine (oil of turpentine) (Reaffirmed 2003)
712-1984	Specification for building limes. (Reaffirmed - 1995)
1200 (Pt. XII)-1976	Method of measurements of plastering and pointing
1200 (Pt.XIII)-1994	Method of measurements of white washing, colour washing, distempering and other finishes
I. S. CODE NO.	**S U B J E C T**
1200 (Pt.XV)-1987	Methods of measurements of painting, polishing & varnishing.

2095-2011-Pt.I ; 2001-PT II-1996-PT III)	Gypsum plaster boards
2096-1992	Asbestos cement flat sheets.
2339-1963	Aluminium paint for general purposes, in dual container. (Reaffirmed – 1999)
2547-1976 (Pt I & II)	Gypsum building plaster (Part I-Reaff. 2007)
2933-1975	Enamel, Exterior (a) Under coating (b) Finishing
5410-2013	Cement paint

I. S. CODE NO.	SUBJECT
6278-1971	Code of practice for white washing & colour washing. (Reaffirmed - 1991)
14276-195	Cement particle board
15. DEMOLITION AND DISMANTLING:	
1200(Pt.XVIII)-1974	Method of measurements of demolition and dismantling
16. SAFETY CODES	
818-1968 (Reaf-03)	Safety and healthy requirements in Electric and gas welding and cutting operations.
3696 (Pt.I)-1 987	Safety code for scaffolds
3696 (Pt.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
5916-2013	Safety code for construction involving use of hot bituminous materials
6922-1973	Structural subject to underground blasts code of practice for safety and design of structure subject to underground blasts.
7293-1974	safety code for Working with construction machinery
IRC:15-2011	Specifications and Code of Practice for Construction of Concrete Roads
IRC:44-2008	Guidelines for Cement Concrete Mix Design for Pavement"
IRC:SP:63-2004	Guidelines for the Use of Interlocking Concrete Block Pavement
IRC 58 -2015	Guidelines for the design of Plain Jointed Rigid Pavements for Highways
MORTH	Specification for Road & Bridge works
SSPC-SP3 (SSI-St3)	Surface Preparation of Structural steel surface -Power Tool Cleaning–Swedish standard ST 3

SSPC-SP10(SSI-Sa2 ½),	Surface Preparation of Structural steel surface – Shot Blasting - Swedish standard Sa 2 1/2

III – MANDATORY TESTS

NOTES:

The mandatory tests shall be carried out when the quantity of materials to incorporated in the work exceeds the minimum quantity specified.

Optional tests specified or any other tests, shall be carried out in case of specialised works or important structures as per direction of the Engineer-in-Charge.

Testing charges, including incidental charges and cost of sample for testing shall be born by the contractor for all mandatory tests.

In case of non-IS materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant IS specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractor for such tests.

THE MANDATORY TESTS SHALL BE AS FOLLOWS:

Material	**Test**	**Field / laboratory test**	**Test procedure**	**Minimum quantity of material / Work**	**Frequency of testing**
Reinforced cement concrete work **Note:- IS no. refered shall be the latest revision applicable.**					
Water for Construction purposes	Ph value Limits of Acidity Limits of Alkality Percentage of solids Chlorides Suspended matter Sulphates Inorganic solids Organic solids	Lab	IS 3025	Water from each source	Before commencement of work & thereafter : Mandatory – Once in one year from each source;Optional: once in 3 months from eachsource; Municipal supply - optional.

Reinforced cement concrete	b) slump test	Field	IS: 1199	a) 20 cu.m. for slabs, beams and connected columns . b) 5 Cu.m in	a) 20 cu.m. Part there of or more frequently as required by the Engr.-in-Charge. b) Every 5 Cu.m.
	c) cube test	Lab	IS : 516	a) 20 cu.m. In slab, beams, & connected columns. b) 5 cum in case of columns	a) every 20 cum of a day's concreting .(Ref. as per frequency of sampling). b) Every 5 cum.
Ready mixed cement (IS-4926)	Cube test	Lab	IS-516 and as per para 6.3.2 of IS-4926-2003	50 cum	One for every 50cum of production or every 50 batches,
Note : for all other small items and where RCC done in a day is less than 5 cum, test may be carried out as required by Engineer-in-Charge.					
Mortars:					
Lime	Chemical & physical properties of lime	Laboratory	IS; 6932 (part 1 to x)	5 M.T.	10 M.T. or part there of as decided by the Engineer-in-Charge
Sand	Bulking of Sand	Field		20 CU.M.	Every 20 cu.m or part thereof or more frequently as decided by Engineer-In-Charge

	Silt content	Field	IS:383	20 CU.M.	Every 20 cu.m or part thereof or more frequently as decided by
	Particle size and distribution	Field Laboratory decided by Engr -in-Charge	IS:383	40 CU.M.	Every 40 cu.m. of fine aggregate / sand required in RCC. work only.
	Organic Impurities	Field	.. DO..	20 CU.M.	Every 20 cu.m. or part thereof or more frequently as decided by the Engineer-in-Charge
	Chloride & sulphate		Optional		Once in three months.

Material	**Test**	**Field / laboratory test**	**Test procedure**	**Minimum quantity of material / Work**	**Frequency of testing**
Cement	Test requirement	Fineness (m^2/kg)	IS 4031 (Part-II)	Each fresh lot	Every 50 MT or part
		Normal consistenc	IS 4031 (Part-IV)		
		Setting time (minutes) a) Initial b) Final	IS 4031 (Part-V)		
		Soundnes s a)Le-Chat expansion (mm) b) Autoclave (%)	IS 4031 (Part-III)		
		Compressi ve Strength (Mpa)	IS 4031 (Part-VI)		
Stone Aggregate	a) Percentage of soft or deleterious materials	General visual inspection / Lab test where required by the Engr-	IS 2386 Part II	One test for each source	One test for each source
	Particle size distribution	Field / Lab	-	10 cu.m	Every 40 cum. Or part thereof and

	Once in three months for each source for coarse and fine aggregates required in RCC works, for a minimum quantity - 10 cum for coarse aggregate and 40 cum for fine aggregate.				
	) Estimationof Organic impurities	Field / Lab	IS 2386 Part II	10 Cum	-do-
	b) Specific Gravity	Field / Lab	IS 2386	10 Cum	-do-
	Bulk Density	Field / Lab	IS 2386	10 Cum	-do-
Material	**Test**	**Field / laboratory test**	**Test procedure**	**Minimum quantity of material / Work**	**Frequency of testing**
	b) Aggregate crushing strength	Field / Lab	IS 2386	10 Cum	-do-
	c) Aggregate impact value	Field / Lab	IS 2386	10 Cum	-do-
Timber	Moisture	Field (by moisture meter) Laboratory test as required by Engineer-in-Ch.		1 Cu.M.	Every one Cum or part thereof
Flush Door	End immersion test Knife test Adhesion test	Laboratoy	IS: 2202 (Part 1) & (Part II)	26 shutters	As per sampling and testing as instructed by the Engineer-in-Charge.

Bricks	Testing of bricks / brick tiles for dimensions Compressive strength Water absorption Efflorescence	Laboratory	IS 3495 Part I to IV	No. of bricks to be selected & bricks lot 20 : 2001 to 10000 32 : 10001 to 35000 50 : 35001 to 50000 20 : for every addl. 50000 or part thereof. If < 20000, As per decision of EIC.	Permissible defective bricks in the sample 1 2 3 1

Material	Test	Field / laboratory test	Test procedure	Minimum quantity of material / Work for carrying out	Frequency of testing
Concrete Blocks	Dimensions of block Block Density Compressive strength Water absorption Drying shrinkage Moisture movement	Field Laboratory	IS 2185 – Part 1	20 blocks from every consignment of 5000 blocks.	As per sampling and testing as instructed by the Engineer-in-Charge.
Steel for RCC	Physical tests a) Tensile strength b) Retest c) Re-bound test d) Nominal mass e) Bend test f) Elongation test g) Proof stress	Lab / field	IS 1608 IS 1786 IS 1786 IS 1786 IS 1599 IS 1786 IS 1786	Each lot from each source from each diameter of bar: Below 100 Tonnes Dia < 10 mm one sample for each 25 tonnes or part thereof If dia is >10 mm but less than 16 mm: One sample each 35 tonnes or part thereof. If dia >16 mm one sample for each 45 tonnes	Above 100 Tonnes Dia < 10 mm one sample for each 40 tonnes or part thereof If dia is >10 mm but less than 16 mm One sample for each 45 tonnes or part thereof. If dia >16 mm one sample for each 50 tonnes.

	Chemical Composition		IS 1786 as pe latest amendmer ts		For every batch no.and diameter wise to be tested and as directed by the Engineer-in-Charge.
Soil core test	OMC Proctor density		As per IS 12175	Two for every 50 sqm	As per para 1.10 & 1.11 of this book
Mosaic tiles			As per IS 13801 Para 14.6	5000 tiles and more for each manufacturer & thereafter for every	
Ceramic tiles			As per IS 13630	3000 tiles and more for each manufacturer and thereafter for every 3000 tiles or part thereof.	

OTHER MANDATORY TESTS: Soil core tests; Testing aggregate - particle size distribution; Ceramic tiles, Mosaic tiles

CI pipes: Dimensional, mass, Hydrostatic; GI pipes; Lead; RCC hume pipes; Stoneware pipes

ROAD WORK: Soil core tests; Grading of metal for WBM; Bitumen grade; Bitumen content; Load test on concrete gratings.

OPTIONAL TESTS: Testing aggregate-surface moisture, impact value pectrographic; alkali reaction; Dimensional tests of bricks; Testing the mass of zinc coating on GI door frame, steel windows, test for chemical and physical properties; Anodic coating on aluminium fittings and aluminium sections, Unit weight of aluminium sections;

Testing structural steel; Chequered plate, Unit weight, Thickness, Chemical and physical properties

Presence of preservative on factory made panelled door, kiln seasoned chemically treated wood products, Moisture content in wood products.

TESTING, TOLERANCE, ACCEPTANCE AND MODE OF PAYMENT:

a) The material should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant IS for acceptance. Such materials shall be accepted as standard.
b) Payment shall be restricted to standard unit mass, or as specified in the schedule of work, without making any cost adjustment towards mass or any other properties, provided the material pass all the tests and tolerances are within the specified limits.In case of non-standard materials, materials not covered under any IS Specifications, such as aluminium sections, the payment shall be made based on the actual unit weight basis as determined by testing at random sampling.

SECTION 'A'- CIVIL WORKS

1. EARTH WORK

1.1. SCOPE OF WORK:

The scope of work covered under this specifications pertains to excavation of foundations, trenches, pits and over areas, in all sorts of soils, soft and hard rock, correct to dimensions given in the drawing including shoring, protections of existing underground utilities if any, such as water lines, electric cables etc., dewatering and shoring if necessary, stacking the useful materials as directed within the lead specified, refilling around the foundation and into the plinth with selected useful excavated earth and disposing off the surplus earth/materials within specified lead and finishing the surface to proper levels, slopes and camber etc. all complete.

1.2. SITE CLEARANCE:

Before the earth work is started the area coming under cutting and filling shall be cleared of all obstructions, loose stones, shrubs, rank vegetation, grass, brush-wood, trees and saplings of girth upto 30 cm. measured at a height of one metre above ground and rubbish removed upto a distance of 150 metres outside the periphery of the area under clearance. The roots of trees shall be removed to a minimum depth of 60 cm. below ground level, or a minimum of 30cm. below formation level whichever is lower, and the hollows filled up with earth, levelled and rammed. This work is deemed to be included in the earth work items and no separate payment will be admissible for the work.

The trees of girth above 30 cm. measured at a height of one meter above ground, shall only be cut after permission of the Engineer-in-charge is obtained in writing. The roots shall also be removed as described in the preceding sub-para. Payment for cutting and removing roots of such trees shall be made separately. Any material obtained from the site will be the property of the MDL and the useful materials as decided by the Engineer-incharge will be conveyed and properly stacked as directed within the lead specified.

1.3. SETTING OUT AND MAKING PROFILES :

Masonry or concrete pillars will be erected at suitable points in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G. T. S. or any other permanent bench mark approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings or Burjis shall be made to show the correct formation levels before the work is started. The contractor shall supply labour and materials for setting out and making profiles and Burjis for the work at his own cost and the same shall be maintained during the excavation work. The grid Co-ordinate or other reference points Shall be confirmed along with E.I.C. It shall be the responsibility of the contractor to set out centre lines correctly with reference to the drawings and install substantial reference marks. Checking of such alignment by the E.I.C will not absolve the contractor from his responsibility to execute the work strictly in accordance with the drawings.

1.4. EXCAVATION :

The contractor shall notify the Engineer-in-charge before starting excavation and before the ground is disturbed, to enable him to take existing levels for the purpose of measurements. The ground levels shall be taken at 5 to 15 metres intervals in uniformly sloping ground and at closer distance where local mounts, pits or undulations are met with, as directed by the Engineer-in-charge. The ground levels shall be recorded in field books and plotted on plans, which shall be signed by the Contractor and the Engineer-in-charge, before the earth work is actually started. The labour required for taking levels, shall be supplied by the Contractor at his own cost. The Contractor shall perform excavation in all types of soils, murrum, soft and hard rock, boulders etc. in foundation, over areas and in trenches to widths, lines, levels, grades and curves as shown in the drawing or lesser widths, lines and levels as directed by the Engineer-in-charge and as per items in the schedule of quantities.

1.4.1. The item in the schedule of quantities shall specify the excavation in trenches or over areas. For this purpose, the excavation for any depth in trenches for foundation not exceeding 1.5 m. in width or 10 sqm. on plan shall be described as **Excavation in foundation trenches.**

1.4.2. Excavation exceeding 1 .5m in width as well as 10 sqm. on plan (excluding trenches for pipes, cables etc.) and exceeding 30 cm in depth shall be described as **Excavation over areas.**

1.4.3. Excavation exceeding 1.5m in width as well as 10 sqm. on plan but not exceeding 30 cm. in depth shall be described as Surface Excavation.

1.5. Classification of Earth Work: The earth work shall be classified under the following main categories and measured separately for each category.

a) All types of soils, murrum, boulders.

b) Soft rock.

c) Hard rock.

1.5.1.

a) **All types of Soils, Murrum, Boulders :** This includes earth, murrum, top deposits of agricultural soil, reclaimed soil, clay, sand or any combination thereof and soft and hard murrum, shingle etc. which is loose enough to be removed with spades, shovel and pick axes. Boulders not more than 0.03 cum. in volume found during the course of excavation shall also fall under this classification.

b) **Excavation in Soft Rock :** This shall include all materials which are rock or hard conglomerate, all decomposed weathered rock, highly fissured rock, old masonry, boulders bigger than 0.03 cum. in volume but not bigger than 0.5 cum. and other varieties of soft rock which can be removed only with pick axes, crow bars, wedges and hammers with some difficulty. The mere fact that the contractor resorts to blasting and/or wedging and chiselling for reasons of his own, shall not mean the rock is classificable as hard rock.

c) **Excavation in Hard Rock :** This includes all rock other than soft rock mentioned in para 1.5.1 (b) viz. soft rock, occurring in masses, boulders having approximate volume more than 0.5 cum. plain or reinforced cement concrete, which can best be removed by blasting or chiselling and wedging where blasting cannot be permitted owing to any restriction at site.

i) **Excavation in Hard Rock by Blasting :** Where blasting is permitted the excavation in rock shall be done by means of blasting. No heavy blasting will be permitted and only controlled/muffled blasting will be permitted at the discretion of the Engineer-in-Charge. The Contractor shall be governed by the relevant statutory laws, rules and regulations on explosives, pertaining to the acquisition, transport, storage, handling and use of explosive which shall be rigidly followed and shall obtain himself all necessary materials and equipment for blasting. Blasting shall be executed through a licensed blaster with prior permission from police authorities. Prior to blasting sufficient notice shall be given to concerned parties to avoid danger to people, materials and nearby structures. All the damages caused by careless blasting if any shall be made good by the contractor at his own expenses.

ii) **Excavation in Hard Rock by Chiselling and Wedging :** Where blasting is not permitted and if the Engineer-in-Charge so desires, the excavation shall be done by chiselling and wedging or any other agreed method.

NOTE : All the excavated hard rock obtained shall be stacked properly and neatly within the specified lead by the contractor as directed by the Engineer-in-Charge.

1.6. EXCAVATION PARAMETERS : The excavation under all classifications in areas in trenches or in pits shall be carried out systematically. Cutting shall be done from top to bottom and no under-pining or undercutting will be allowed. The bottom and sides of excavation shall be dressed to proper level, slopes,steps, camber etc. by removing high spots, and ramming thoroughly as directed by the Engineer-in-charge.

All the excavation shall be carried out strictly to the dimensions given in the drawing. The width shall generally be of the width of mudmat concrete and depth as shown in drawing or as directed by the Engineer-in-Charge, according to availability of the desired bearing capacity of soil below. Any excavation if taken below the specified depths and levels, the contractor shall at his own cost fill up such overcut to the specified level with cement concrete 1:4:8 in case of excavation in all types of soils and with cement concrete 1:2:4 in case of excavation in soft and hard rock.

After the excavation is completed, the contractor shall notify the Engineer-in-Charge to that effect and no further work shall be taken up until the Engineer-in-Charge has approved the depth and dimensions and also the nature of foundation materials. Levels and measurements shall also be recorded prior to taking up any further work. Contractor has to ensure Proper temporary barricading around the excavated area till backfilling in pits is completed.

1.7. SHORING :

Unless separately provided for in the schedule of quantities, the quoted rate for excavation shall include excavation of slopes to prevent falling in soil by providing and/or fixing, maintaining and removing of shoring, bracing etc. The contractor would be responsible for the design of shoring for proper retaining of sides of trenches, pits etc. with due consideration to the traffic, superimposed loads etc. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. It shall be removed as directed after items for which it is required are completed. Should the slips occur, the slipped material shall be removed and slope dressed to a modified stable slope. Removal of the slipped earth will not be measured for payment.

DEWATERING :

Unless specifically provided for as a separate item in the schedule of quantities, rate shall also include bailing or pumping out all water which may accumulate in the excavation during the progress of further works such as mud mat concrete, R.C. footings, shuttering etc. either due to seepage, springs, rain or any other cause and diverting surface flow by bunds or other means. Care shall be taken to ensure that the water discharged sufficiently away from the foundations to keep it free from nuisance to other works in the neighbourhood.

1.8. DISPOSAL OF EXCAVATED MATERIALS :

a) **ANTIQUITES :** Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.

b) **USEFUL MATERIALS :** Any material obtained from the excavatiion which in the opinion of the Engineer-in-Charge is useful, shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

No material excavated from foundation trenches of whatever kind they may be are to be placed even temporarily nearer than about 3 m. from the outer edge of excavation. Discretion of the Engineer-in-Charge in such cases is final. All materials excavated will remain the property of the MDL. Rate for excavation includes sorting out of the useful materials and stacking them separately as directed within the specific lead.

Materials suitable and useful for backfilling or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or other elevation shown on the plan or as directed by the Engineer-in-Charge. **Materials not useful in anyway shall be disposed off, levelled and compacted as directed by the Engineer-in-**

charge within a specified lead. The site shall be left clean of all debris and levelled on completion.

1.9. BACKFILLING IN SIDES OF FOUNDATIONS, PLINTH, UNDER FLOOR ETC. :

The back filling shall be done after the concrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for back filling, it shall be brought from the place where it was temporarily deposited and shall be used in backfilling. The scope of work for back filling/filling in foundation, plinth, under floors etc. shall include filling for all the buildings covered under the contract. Surplus earth available from one building, if required, shall be used for backfilling/filling for other buildings also within the specified lead mentioned in the item.

All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be backfilled to the original surface with approved materials in layers not exceeding 150 mm. in thickness, watered and well consolidated by means of rammers to atleast 90% of the consolidation obtainable at optimum moisture content (Proctor density). Flooding with water for consolidation will not be allowed. Areas inaccessible to mechanical equipment such as areas adjacent to walls and columns etc. shall be tamped by hand rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones, shingle or boulder not larger than 75 mm. in any direction,salt, clods, organic or other foreign materials which might rot. The backfilling in plinth and under floors shall be done in similar way in layers not exceeding 150 mm. thick and shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density.

Test to establish proper consolidation as required will be carried out by the Contractor from MDL approved Testing Lab . Two tests per 50 sqm. will be taken to ascertain the proper consolidation.

1.10. FILLING IN PLINTH AND UNDER FLOORS:

After the available suitable excavated materials are exhausted as backfilling, the contractor shall notify the Engineer-in-Charge, of the fact and levels taken jointly with Engineer-in-Charge. The earth, murrum, sand, gravel etc. or such materials suitable for filling proposed to be filled under floors and so mentioned in the item of schedule of quantities shall then be brought to site from approved locations and sources.

i) **Earth Filling :** The earth, soft murrum etc. so brought shall be filled up in layers of 15 cm depth, each layer being well watered and consolidated by approved hand or mechanical tampers or other suitable means to achieve the required density.

ii) **Gravel or Sand Filling :** Gravel if required to be filled under floors, shall be single washed gravel of approved quality and of size varying from 12 mm. to 20 mm. it shall be uniformly blinded with approved type of soil and/or sand to obtain full compaction. Gravel shall be filled in specified thickness and shall be well watered and rammed entirely to the satisfaction of the Engineer-in-Charge.

If sand is required to be filled under floors,it shall be clean, medium grained and free from impurities. The filled in sand shall be kept flooded with water for 24 hrs. to ensure maximum consolidation. Any temporary work required to maintain sand under flooded condition shall be done by the contractor at his own cost. The surface shall then be well dressed and got approved from Engineer-in-Charge before any other work is taken over the fill.

1.11. LEAD & LIFT

LEAD : The lead for disposal/deposition of excavated materials shall be as specified in the respective item of work. For the purpose of measurements of lead, **the area to be excavated or filled or area on which excavated material is to be deposited/disposed off shall be divided in suitable blocks and for each of the block, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route adopted.**

LIFT : Lift shall be measured from ground level. Excavation up to 1.5 m depth below ground level and depositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5 m or part thereof. Obvious lift shall only be measured; that is lifts inherent in the lead due to ground slope shall not be measured except for lead upto 250 m. All excavation shall be measured in successive stages of 1 .5 m stating the commencing level. This shall not apply to cases where no lift is involved as in hill side cutting.

1.12. MODE OF MEASUREMENTS:

1.12.1. All excavation in areas shall be measured net. The dimensions for the purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, rafts or other foundations, multiplied by the mean depth from the surface of ground determined by levels. Excavation for side slopes will not be paid for. Excavation in areas having depths less than 30 cms. shall be measured as surface excavation on square metre basis,mentioning the average depth of excavation.

Reasonable working space beyond concrete dimensions shall be allowed for waterproofing and shuttering works in underground water tanks, sumps, septic tanks etc., where considered necessary in the opinion of the Engineer-in-Charge. However the same shall be limited to the following:

i) Waterproofing and works upto 2M depth	Maximum upto 600mm from face of concrete surface
ii) Waterproofing and works beyond 2M depth	Maximum upto 900mm from face of concrete surface.

1.12.2. Wherever direct measurements of rock excavation are not possible, volume of rock be calculated on the basis of length, breadth and depth of stacks made at site as mentioned in para 1.5.1 (c). The net volume shall be worked out by reducing it by 50%, taking the voids into consideration as 50%. Similarly to arrive at net quantity to be paid in the case of soil, reduction @ 20% of corresponding stack/truck measurements shall be made.

1.12.3. The rate for excavation shall include carting and disposing and levelling the excavated materials within the specified lead. The rate shall also be inclusive of cost of all tools, plants, explosives, shoring, dewatering at various stages, labour, materials etc. to complete all the operations specified.

1.12.4. The backfilling and consolidation in sides of foundation and in plinth with excavated material will be paid separately as per the rates in schedule of quantities. Actual quantity of consolidated filling shall be measured and paid in cubic metres upto two places of decimal. conveying within the specified lead, picking of selected stacked materials, conveying it to the place of final backfill, compaction to the required proctor density etc.

1.12.5. Payment for filling and consolidation inside the trenches, sides of foundations, plinth etc. with selected materials brought by the contractor other than the excavated material, shall be paid for separately as per the rates in schedule of quantities which includes cost of such materials/excavation, royalty, its conveyance within the specified lead, watering, consolidating, dressing etc. Actual quantity of consolidated filling shall be measured and paid in cubic metres upto two places of decimal.

1.12.6. The rate quoted in cum. for items of excavation is deemed to include the necessary additional quantity of excavation involved beyond the authorized dimensions of para no 1.13 (for waterproofing and shuttering works in underground watertanks, sumps, septic tanks, Raft etc.) which may be necessary to be carried out for carrying out the work in an engineering manner, decided upon by the contractor. Therefore no extra payment will be made for any excavation done other than the required quantity as per the plan dimension indicated in the drawings.

1.12.7. Measurements for excavation over areas shall be determined by levels or by "Dead men" or both at the discretion of the Engineer-in-Charge. If however the Engineer-in-Charge decides on measurement by levels, levels of site shall be jointly taken and recorded by the Engineer-in-Charge or his representatives and the contractor, before commencement of the work and after completion of the work and the quantity of work done shall be computed based on these levels. The volume of earth work shall be computed based on "Simpsons formula" or any other approved method at the discretion of the Engineer-in-Charge.

* * * *

2. ANTITERMITE TREATMENT:

2.1. GENERAL :

Preconstructional anti-termite treatment is a process in which soil treatment is applied to a building in early stages of its construction. The purpose of antitermite treatment is to provide the building with a chemical barrier against the sub-terranean termites.

Antitermite treatment being a specialized job, calls for thorough knowledge of the chemicals, soils, termite to be dealt with and the environmental conditions, in order to give effective treatment and lasting protection to the property undergoing treatment. It is, therefore, imperative that the works of antitermite treatment should be got executed through specialized agencies only. The specialized agency should be preferably a member of the Indian Pest Control Association and shall have sufficient experience of carrying out similar works of magnitude envisaged in this tender.

The preconstructional soil treatment is required to be applied during the construction stages of the sub-structure upto plinth level. The contractor has to be watchful of the various stages of sub-structure works and arrange to carry out the soil treatment in time after proper co-ordination with E.I.C and other contractors if any, working at site.

2.2. SCOPE :

The scope of preconstructional antitermite treatment covers the soil treatment with approved chemicals in water emulsion in foundation trenches for columns, plinth beams, pile caps, brick walls, service trenches, lift pits, steps, ramps etc. in top surfaces of plinth filling, at junction of walls and floor,in expansion joints etc. in stages as detailed in this specifications and drawings. Unless otherwise stipulated, the antitermite treatment will be carried out as per I.S.6313 (part II) 1981 and/or as per direction of the Engineer-in-Charge.

2.3. SITE PREPARATION :

In order to ensure uniform distribution of the chemical emulsion and to assist penetration, the following site preparation shall be carried out:

a) Remove all trees, stumps, logs or roots from the building site.

b) Remove all concrete form work if left anywhere, levelling pegs, timber off-cuts and other builders debris from the area to be treated.

c) If the soil to be treated is sandy or porous, preliminary moistening will be required to fill capillary spaces in soil in order to prevent the loss of emulsion through piping or excessive percolations.

d) In the event of water logging of foundation, the water shall be pumped out before application of chemical emulsion and it should be applied only when the soil is absorbent.

e) On clays and other heavy soils where penetration is likely to be slow and on sloping sites, where run-off of the treating solution is likely to occur, the surface of the soil should be scarified to a depth of 75 mm. atleast.

f) All sub-floor levelling and grading should be completed, all cutting, trenches and excavations should be completed with backfilling in place, borrowed fill must be free from organic debris and shall be well compacted. If this is not done supplementary treatments should be made to complete the barrier.

2.4. CHEMICAL TO BE USED :

The effectiveness of chemical depends upon the choice of the chemical, the dosage adopted and the thoroughness of application. The chemical solutions or emulsions are required to be dispersed uniformly in the soil and to the required strength so as to form an effective chemical barrier which is lethal and repellent to termites.

Soil Treatment : One of the approved chemicals in water emulsion, recommended by the Indian Pest Control Association (IPCA), and approved by the Engineer-in-Charge, shall be used uniformly over the area to be treated.

The contractor should produce voucher(s) for the chemical purchased and should get verified the sealed container(s) of the specified chemical from the Engineer-in-Charge before preparing the emulsion/use for the treatment.

2.5. MODE AND RATE OF APPLICATION :

The chemical emulsion as stated above will be applied uniformly by sprayers at the prescribed rates as detailed below in all the stages of the treatment.

2.5.1. Treatment in Foundation Trenches : In case of normal wall load bearing structures, column pits, wall trenches and basement, the treatment shall be @ 5 ltrs./sqm. of surface area of the bottom and sides to a height of atleast 300 mm. After the foundation work, the sides shall be treated @ 7.5 ltrs./sqm. of vertical surface of substructure on each side. After the earth filling is done, treatment shall be done by rodding the earth at 150 mm. centers close to wall surface and spraying the chemical with the above dose i.e. 7.5 ltrs./sqm.

In case of framed structure, the treatment shall start at a depth of 500 mm. below ground level. From this depth the backfill around the columns, beams and R.C.C. basement walls shall be treated @ 7.5 ltrs./sqm. of the vertical surface and @ 5 ltrs./sqm. for the horizontal surface at the bottom in the trenches/pits.

2.5.2. Treatment on Top Surfaces of Plinth Filling : The top surface of the filled earth within plinth walls shall be treated with chemical emulsion at the rate of 5 litres/sqm. of the surface area before sub-base to floor is laid. If filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes upto 50 to 75mm. deep at 150 mm. centers both ways shall be made with crow bars on the surface to facilitate saturation of the soil with the emulsion

2.5.3. Treatment at Junction of Walls and Floors : Special care shall be taken to establish continuity of the vertical chemical barrier on the inner wall surfaces from the finished ground level (or from level where the treatment had stopped) upto the level of the filled earth surface. To achieved this a small channel 30 x 30 mm. shall be made at all the junctions of wall/column with floor (before laying sub-grade) and rod holes made in the channel upto the finished ground level at 150 mm apart and the iron rod moved backward and forward to break the earth and chemical emulsion poured along the channel @ 7.5 litres (or at recommended quantity) per sqm. of the vertical wall/column surfaces so as to soak the soil right upto the bottom. The soil shall be tamped back into place after this operation.

2.5.4. Treatment for Expansion Joints : The soil beneath the expansion joints shall receive special attention when the treatment under 2.5.1 above is in progress. This treatment shall be supplemented by treating through the expansion joint after sub-grade has been laid at the rate of 2 litres per metre length of expansion joint.

2.6. PRECAUTIONS DURING TREATMENT :

a) Utmost care shall be taken to see that the chemical barrier is complete and continuous. Each part of the area shall receive the prescribed dosage of chemical emulsion.

b) The treatment should not be carried out when it is raining or when the soil is wet with rain or sub-soil water.

c) Once formed, the treated soil barrier shall not be disturbed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.7. PRECAUTIONS FOR HEALTH HAZARDS AND SAFETY MEASURES :

2.7.1. All the chemicals mentioned above are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mist or swallowed. Persons handling or using these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given in 2.7.2 to 2.7.5 particularly when handling these chemicals in the form of concentrates

2.7.2. These chemicals are usually brought to the site in the form of emulsifiable concentrates. The containers should be clearly labelled and should be stored carefully so that children and pets cannot get at them. They should be kept securely closed.

2.7.3. Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water specially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they shall be flushed with plenty of soap and water and immediate medical attention should be sought.

2.7.4. The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed during mixing.

2.7.5. Care should be taken in the application of chemicals/soil-toxicants to see that they are not allowed to contaminate wells or springs which serve as source of drinking water.

2.8. GUARANTEE :

The contractor has to furnish the guarantee for 10 (ten) years from the date of completion of work, stating that in case of reappearance of termites within the building area due to defective materials or workmanship or due to any other reasons, the contractor will carry out the necessary post constructional treatment to keep the entire area free from termite, once again, without any extra cost during the guarantee period.

2.9. MODE OF MEASUREMENT :

The payment will be made on the basis of plinth area measurements at ground floor only for all the stages of treatment in sqm. correct to two places of decimals. Rate includes the cost of materials, labour and all tools,plants, sprayers required for complete operation.

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3. HARD CORE / SOLING UNDER FLOORS / FOUNDATIONS :

3.1. SCOPE OF WORK :

The work covered under this specification includes all type of soling work either by bricks or by rubble stones laid under floors/foundations, hand packed, complete as per under mentioned specification and applicable drawings.

3.2.1. RUBBLE STONE SOLING : The rubble stone shall be of best variety of black trap/granite/basalt or other approved variety of stone available locally. The stone shall be hard, durable, free from defects and of required size and shall be approved by the Engineer-in-Charge before incorporation in the work.

3.2.2. Preparation of Surface : The bed on which rubble soling is to be laid shall be cleared of all loose materials, levelled, watered and compacted and got approved by the Engineer-in-Charge before laying rubble soling. Cable or pipe trenches if shown in the drawing and as required by the Engineer-in-Charge shall be got done before the soling is started.

3.2.3. Workmanship : Over the prepared surface, the stone shall be set as closely as possible and well packed and firmly set. The stones shall be of full height and shall be laid so as to have their bases of the largest area resting on the sub-grade. Soling shall be laid in one layer of 230 mm. or 150 mm. or other specified thickness and no stones shall be less than 230 mm. or 150 mm. depth or specified thickness of soling with a tolerance of 25mm.

After packing the stones properly in position, the interstices between them shall be carefully filled with quarry spoils or stone chips of larger size possible, to obtain a hard, compact surface. Spreading of loose spoils or stone chips is prohibited.

The entire surface shall be examined for any protrusions and the same shall be knocked off by a hammer and all interstices shall be filled with approved murrum. Excess murrum if any over the surfaces shall be removed. Unless otherwise specified, the murrum shall be supplied by the contractor at his own cost from the selected areas. The surfaces shall then be watered and consolidated with mechanical or sufficiently heavy wooden tampers and log-rammers as approved by the Engineer-in-Charge to give the required slope or level and dense sub-base. After compaction, the surface shall present clean look. Adequate care shall be taken by the contractor while laying and compacting the rubble soling to see that concrete surfaces in contact with soling are not damaged.

3.3. MODE OF MEASUREMENT :

The quoted rate shall be per square metre of the soling of specified thickness or in cu.m basis as per the BOQ (schedule of quantities). The linear dimensions shall be measured upto two places of decimals of a metre and are worked out correct to the two places of decimals of a square metre. Plan areas of soling work actually done limiting to the dimensions as per drawings shall be measured for payment. The rate shall include all the materials, labour, transport etc. and no extra payment shall be made for work done at different levels. The rate shall also include the cost of preparation of surface, all materials and labour, watering, consolidation etc. all complete.

* * *

4. PLAIN / REINFORCED CONCRETE AND ALLIED WORKS:

4.1. SCOPE :

Scope of the specification deals with the structural and general use of plain and reinforced cement concrete.. The specifications cover the qualitative and quantitative requirements in respect of selection of ingredients, proportioning, manufacture of concrete, transport, placing, consolidation, curing, finishing, acceptance criteria etc., These specifications also cover the requirement of form work and reinforcement.

4.2. Unless otherwise specified, the manufacture and placing of concrete shall be done by weigh batching. However, in the specific cases where mechanized batching system (Ready mix concrete), mechanical transport and pumping is specified the same shall be followed as per the terms of the contract.

4.3. CEMENT CONCRETE (PLAIN AND REINFORCED):

4.3.1. The quality of materials and method and control of manufacture and transportation of all concrete work in respect of mix, whether reinforced or otherwise, shall conform to the applicable portions of these specifications.

4.3.2. Mandatory tests: The Engineer-in-Charge shall have the right to inspect the sources of materials, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipments and the quality control system. The contractor shall arrange such an inspection and the Engineer-in-Charge approval shall be obtained prior to starting the concrete work. List of mandatory test for RCC to be carried out is enclosed as Annexure "A".

4.3.3. Materials for Standard Concrete : The ingredients to be used in the manufacture of standard concrete shall consist solely of a standard type Portland/Portland puzzolana cement, clean sand, natural coarse aggregate, clean water, ice and admixtures if specially called for on drawings or schedule of quantities.

4.3.3.1. Cement: Unless otherwise specified or called for in the contract specifications, cement shall be any of the following and the type selected should be appropriate for the intended use and as per the contract conditions, specifications and drawings.

a) 33 Grade Ordinary Portland cement conforming to IS 269

b) 43 Grade ordinary Portland cement conforming to IS 8112

c) 53 Grade ordinary Portland Cement conforming to IS 12269

d) Portland slag cement conforming to IS 455.

e) Porland pozzolana cement (fly ash based) conforming to IS 1489 (Part I)

f) *Portland pozzolona cement (calcined clay based* conforming to IS 1489 (Part 2)

g) Sulphate resisting Portland cement conforming to IS 12330.

In case the job requires specific use of any of the following cements the same shall be used with the prior approval of the EIC and necessary precautions with regard to their setting and hardening time, time required for de-shuttering, curing etc., shall be taken after carefully complying with specific literature with regard to those types.

1. High Alumina cement - conforming to IS 6452
2. Low heat cement - conforming to IS 12600
3. Super sulphate cement - conforming to IS 6909
4. Rapid Hardening cement - conforming to IS 8041
5. Blended Cement for finishing work as below

Other combinations of Portland Cement with mineral admixtures of quality conforming to relevant Indian Standards laid down may also be used in the manufacture of concrete provided that there are satisfactory data on their suitability, such as performance test on concrete containing them and only in such case where in specifically called for in the contract.

4.3.3.1(A). *Mineral Admixtures*

Pozzolana: Pozzolanic materials conforming to relevant Indian Standards may be used with the permission of Engineer-in-charge, provided uniform blending with cement is ensured.

Fly ash (pulverized fuel ash): Fly ash conforming to Grade 1 of IS 3812 may be used as part replacement of **ordinary** Portland cement provided uniform blending with cement is ensured.

Silica fume: Silica fume conforming to a standard approved by the deciding authority can be used as part replacement of cement provided uniform blending with the cement is ensured.

Note: The silica fume (very fine non –crystalline silicon dioxide)is a by-product of the manufacture of silicon,ferrosilicon or the like, from quartz and carbon in electric arc furnace. It is usually used in proportion of 5 to 10 **percent** of the cement content of a mix.

Rice husk ash: Rice husk ash giving required performance and uniformity characteristics may be used with the **approval** of the deciding authority.

Note: Rice husk ash is produced by burning rice husk and contain large proportion of silica. To achieve amorphous state, rice husk may be burnt at controlled temperature. It is necessary to evaluate the **product** from a particular source for performance and uniformity since it can range from being as deleterious as silt when incorporated in concrete. Water demand and drying shrinkage should be studied before using rice husk.

Metakaoline: Metakaoline having fineness between 700 to 900m^2/kg may be used as pozzolanic material in concrete.

Note: Metakaoline is obtained by calcination of pure or refined kaolintic clay at a temperature between 650 0C and 850^{0}C, followed by grinding to achieve a fineness of 700 to 900 m^2/kg. The resulting material has high pozzolanicity.

Ground Granulated Blast Furnace Slag: Ground granulated blast Furnace slag obtained by grinding granulated blast furnace slag conforming to IS 12089 may be used as part replacement of ordinary Portland cement provided uniform blending with cement is assured.

A certified report attesting to the conformity of the cement to I.S. specifications by the cement manufacturers chemist shall be furnished to the Engineer-in-Charge, if demanded. The Contractor, shall make his own arrangements for the storage of adequate quantity of cement at no extra cost at the site of work as per instructions and approval of the Engineer-in-Charge.

Specification for Storage:

Cement in bags shall be stored and stacked in a shed, which is dry, leak-proof and moisture proof as far as possible. Storage under tarpaulins will not be permitted. Flooring of the shed shall consists of the two layers of dry bricks laid on well consolidated earth to avoid contact of cement bags with the floor. Stacking shall be done about 150 to 200 mm clear above the floor using wooden planks. Cement bags shall be stacked at least 450 mm clear off the walls and in rows of two bags leaving in a space of at least 600 mm between two consecutive rows. In each row the cement bags shall be kept closed together so as to reduce air circulation. Stacking shall not be more than ten bags high to avoid lumping under pressure. In stacks more than eight bags high, the cement bags shall be arranged in header

and stretcher fashion i.e alternately lengthwise and crosswise so as to tie the stacks together and minimize the danger of toppling over.

Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage arrangements shall be such that there is no dead storage consignments in cement shall be stored as received and shall be consumed in the order of their delivery.

Cement held in store for a period of ninety (90) days or longer shall be retested before use in work. Should at any time the Engineer-in-Charge have reasons to consider that any cement is defective, then irrespective of its origin and/or manufacturers test certificate, such cement shall be tested immediately at a National Test Laboratory/Approved Laboratory (As Approved by MDL), and until the results of such tests **are** found satisfactory, it shall not be used in any work.

4.3.3.2. Aggregates :

a) **"Aggregate"** in general designates both fine and coarse inert materials used in the manufacture of concrete.

b) **"Fine Aggregate"** is aggregate most of which passes through 4.75 mm I.S. sieve.

c) **"Coarse Aggregate"** is aggregate most of which is retained on 4.75 mm I.S. sieve. Aggregate shall comply with requirement of IS 383. As far as possible preference shall be given to **machine** broken and graded aggregate.

All fine and coarse aggregates proposed for use in the work shall be subject to the Engineer-in-Charge's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer-in-Charge.

Aggregate shall, except as noted above, consists of natural sand, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion to the reinforcement or may impair the strength and/or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary test on concrete specified herein-after.

Sampling and testing : Sampling of the aggregates for mix design and determination of suitability shall be taken under the supervision of the Engineer-in-Charge and delivered to the laboratory, well in advance of the schedule for placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to the Engineer-in-Charge in advance of the work for use, in determining suitability of the proposed aggregate.

Storage of aggregates : All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and earth during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but also at the time of loading into mixer. Rakers shall be used for lifting the coarse aggregate from bins or stock piles. Coarse aggregate shall be piled in layers not exceeding 1.00 metres in height to prevent conning or segregation. Each layer shall cover the entire area of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected. Rejected material after re-mixing may be accepted, if subsequent tests demonstrate conformity with required gradation.

Specific Gravity : Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without special permission of the Engineer-in-Charge.

4.3.3.2.1. Fine Aggregate: Fine aggregate except as noted above, and for other than light weight concrete shall consist of River natural or crushed sand conforming to I.S. 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, loam, alkali, organic matter, mica, salt or other deleterious substances which can be injurious to the setting qualities/strength/durability of concrete.

4.3.3.2.2. Machine Made Sand : Machine made sand will be acceptable, provided the constituent rock composition is sound, hard, dense, non-organic, uncoated and durable against weathering. Machine made sand shall be accepted provided grading & finer particle limits conform to IS 383.

4.3.3.2.3. Screening and Washing : Sand shall be prepared for use by such screening or washing or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions. Sand with silt content more than 3 percent will not be permitted to be used unless the same is washed and silt content is brought within 3% by weight.

Foreign Material Limitations : The percentages of deleterious substances in sand, delivered to the mixer shall not exceed the following:

		Percent by weight	
Sl.No	**Substances**	**Uncrushed**	**Crushed**
i)	Material finer than 75	3.00	15.00
ii)	Shale	1.00	--
iii)	Coal and lignite	1.00	1.00
iv)	Clay lumps	1.00	1.00

v)	Total of all above substances including items (i) to (iv) for	5.00	2.00

GRADATION : Unless otherwise directed or approved, the grading of sand shall be within the limits indicated hereunder.

I.S. Sieve Designation	Percentage passing for			
	Grading Zone -I	Grading Zone -II	Grading Zone -III	Grading Zone -IV
9.5 mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 micron	15-34	35-59	60-79	80-1 00
300 micron	5-20	8-30	8-30	20-65
150 micron	0-10	0-10	0-10	0-15

Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron (I.S.) sieve by not more than 5%, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron (I.S.) sieve or to percentage passing any other sieve size on the coarser limit of grading zone I or the finer limit of grading zone IV. Fine aggregates conforming to Grading Zone IV shall not be used unless mix designs and preliminary tests have shown its suitability for producing concrete of specified strength and workability.

Fineness Modulus : The sand shall have a fineness modulus of not less than 2.2 or more than 3.2. The fineness modulus is determined by adding the cumulative percentages retained on the following I.S. sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron) and dividing the sum by 100.

4.3.3.2.4. Coarse Aggregate : Coarse aggregate for concrete, except as noted above and for other than light weight concrete shall conform to I.S. 383. This shall consist of natural or crushed stone and gravel, and shall be clean and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, sag, alkali, mica, organic matter or other deleterious matter.

The coarse aggregate and fine aggregate shall be tested from time to time as required by the Engineer-in-Charge to ascertain its suitability for use in construction and the charges for testing aggregate shall be born by the contractor as specified herein after.

Screening and Washing : Crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Engineer-in-Charge.

Grading : Coarse aggregates shall be either in single or graded, in both the cases. The grading shall be within the following limits:

I.S. Sieve Designation	Percentage passing for single sized aggregates of						Percentage passing for graded			
	63 mm	40 mm	20 mm	16mm	12 .5mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
75 mm	100	-	-	-	-	-	-	-	-	-
53 mm	85-	100	-	-	-	-	100	-	-	-
37.5 mm	0-30	85-	100	-	-	-	95-100	100	-	-
19 mm	0-5	0-20	85-	100	-	-	30-70	95-100	100	100
13.2 mm	-	-	-	85-100	100	-	-	-	90-1	-
11.2 mm	-	-	-	-	85-100	100	-	-	-	90-
9.5 mm	-	0-5	0-20	0-30	0-45	85-100	10-35	25-55	30-70	40-85
4.75 mm	-	0-5	0-5	0-10	0-20	0-20	0-5	0-10	0-10	0-10
2.36 mm	-	-	-	-	0-5	0-5	-	-	-	-

The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of Engineer-in-Charge, affect adversely the strength and/or durability of concrete, the maximum size of coarse aggregate shall be the maximum size specified above, but in no case greater than 1/4 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 form. Plums above 160 mm. and upto any reasonable size can be used in plain mass concrete work of large dimensions upto a maximum limit of 20% by volume of concrete when specifically approved by Engineer-in-Charge. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm. less than the minimum clear distance between the reinforcing main bars or 5mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the Free State or as loose adherent shall not exceed 1% when determined by laboratory sedim entation tests as per I.S. 2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by I.S.2386.

Foreign Material Limitations : The percentages of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the following :

		Percentage by weight of	
Sl.No.	**Substances**	**Uncrushed**	**Crushed**
i)	Material finer than 75 micron I.S.	3.00	3.00
ii)	Coal and lignite	1.00	1.00
iii)	Clay lumps	1.00	1.00
iv)	Soft fragments	3.00	--
v)	Total of all the above substances	5.00	5.00

4.3.3.3. WATER :

Water used for both mixing and curing shall be clean and free from injurious amounts of deleterious materials.viz oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable waters are generally satisfactory for mixing and curing concrete. In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in I.S. 456 - 2000. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The samples shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

Average 28 days compressive strength of at least three 150 mm. concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water as per IS - 516.

The initial setting time of test block made with the appropriate cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than (+/-) 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of I.S. 4031 (Part 5).

Where water can be shown to contain an excess of acid, alkali, sugar or salt, Engineer-in-Charge may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values:

a) **Limits of acidity :** To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5 ml. of 0.02 normal NaOH. The details of test shall be as per I.S. 3025 (Part 22)

b) **Limits of alkalinity :** To neutralize 100 ml sample of water, using mixed indicator , it should not require more than 25 ml. of 0.02 normal H2SO4. The details of test shall be as per I.S. 3025 (Part 23).

c) Permissible limits for solids shall be as under (water):

Sl.No	Type of solid	Tested as	Permissible limit (Max.)
i)	Organic	IS 3025 (Part 18)	200 mg / l
ii)	Inorganic	IS 3025 (Part 18)	3000 mg / l
Iii)	Sulphates (as SO2)	IS 3025 (Part 24)	400 mg / l
iv)	Chlorides (asCl)	IS 3025 (Part 32)	2000 mg / l for concrete not containing embedded steel and 500 mg/l for
v)	Suspended matter	IS 3025 (Part 17)	2000mg / l

d) The PH value of water shall be not less than 6.

DESIGN MIX CONCRETE :

All reinforced concrete in the works shall be "Design Mix Concrete" as defined in I.S. 456-2000.

4.4.1. Mix Design : This is to investigate the grading of aggregates, water cement ratio, workability and the quantity of cement required to give works cubes of the characteristic strength specified. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to the ACI standard designation ACI- 613 or Design of concrete mixes - Road research Note No.4, Department of Scientific and Industrial Research U.K. or I.S. 10262 - 2009.

After award of the work, if so desired by the contractor, he/they may be allowed by the Engineer-in-Charge, till the designed mix is obtained, to carry out the reinforced concrete work in foundation and plinth as per equivalent nominal mix against the specified design mix concrete as per I.S. Codes. However, all other specification for design mix shall govern for nominal mix also and nothing extra shall be paid for use of extra cement . Where the quantity of RCC is very small, under such circumstance equivalent nominal mix can also be permitted by the Engineer-in-Charge.

GRADES OF CONCRETE : The concrete shall be in grades designated as below.

Group	***Grade***	***Specified Characteristic compressive strength of***
Ordinary concrete	M 10	10
	M 15	15
	M 20	20
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High strength	M 60	60
	M 65	65
	M 70	70
	M 75	75
	M 80	80

NOTE :

1. The characteristic strength is defined as the strength of material below which not more than 5% of the test results are expected to fall.

2. In the designation of a concrete mix, letter "M" refers to the mix and the number to the specified characteristic compressive strength of 150 mm. size cubes at 28 days expressed in N/ mm^2.

3. *Minimum Cement Content, Maximum Water Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum size.*

		Plain concrete			Reinforced concrete		
Sl No.	**Exposure**	**Minimum cement content**	**Maximum Free Water**	**Minimum grade of concrete**	**Minimum Cement Content**	**Maximum Free Water**	**Minimum Grade of concrete**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	-	300	0.55	M-20
ii)	Moderate	240	0.60	M-15	300	0.50	M-25
iii)	Severe	250	0.50	M-20	320	0.45	M-30
iv)	Very	260	0.45	M-20	340	0.45	M-35
v)	***Extreme***	280	0.40	M-25	360	0.40	M-40

NOTE:

1. Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in mineral admixtures. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2. Minimum grade for plain concrete under mild exposure condition is not specified.

Nominal cover to meet Durability Requirements

Exposure	**Nominal concrete cover in mm not**
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

NOTES

1. For main reinforcement up to 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5 mm.

2. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10 mm

3. For exposure conditions ‘severe’ and ‘ very severe’ , reduction of 5 mm may be made, where concrete grade is M 35 and above.

4.

Nominal cover to meet specified period of fire resistance

Fire resis--tance	Nominal cover						
	BEAMS		SLABS		RIBS		COLUMN
	Simply Supported	Continuous	Simply Supported	Continuous	Simply Supported	Continuous	
H	mm	mm	mm	mm	mm	mm	mm
0.5	20	20	20	20	20	20	40
1	20	20	20	20	20	20	40
1.5	20	20	25	20	35	20	40
2	40	30	35	25	45	35	40
3	60	40	45	35	55	45	40
4	70	50	55	45	65	55	40

NOTES

1. The nominal covers given relate specifically to the minimum member dimensions as per drawing

2. Cases that lie below the bold line require attention to the additional measures necessary to reduce the risks of spalling.

Adjustments to Minimum cement contents for Aggregates other than 20 mm Nominal Maximum size:

Sl.No	Nominal maximum Aggregate size mm	Adjustments to Minimum cement content kg/ m3
(1)	(2)	(3)
i)	10	+40
ii)	20	0
iii)	40	-30

For concrete of compressive strength greater than M55 design parameters given in the standard may not be applicable and the values may be obtained from specialized Literatures and experimental results.

The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in the table above.

DEGREE OF CONTROL:

Selection of Water Cement Ratio : Since different cements and aggregates of different maximum size, grading, surface texture, shape and other characteristics may produce concretes of different compressive strength for the same free water cement ratio, the relationship between strength and free water-cement ratio should preferably be established for the materials actually to be used. In the absence of

such data, the preliminary free water-cement ratio (by mass) corresponding to the target strength at 28 days may be selected from the relationship shown in Fig.1 of I.S. 10262 .

Alternately, the preliminary free water cement ratio (by mass) corresponding to the target average strength may be selected from the relationship in Fig.2- I.S. 10262, using the curve corresponding to the 28 days cement strength to be used for the purpose.

Other relevant items to be used with design of mix should strictly conform to the relevant clauses and appendices of I.S. 10262 .

The calculated mix proportions shall be checked by means of trial batches as per IS 10262

The free water cement ratio selected as above, should be checked against the limiting water cement ratio for the requirement of durability and the lower of the two values should be adopted.

Whenever there is a change either in required strength of concrete or water cement ratio or workability or the source of aggregates and/or cement, fresh tests shall be carried out to determine the revised proportion of the mix to suit the altered conditions. While designing mix proportions, over wet mixes shall always be avoided.

While fixing the value for water cement ratio for Design Mix assistance may be derived from the standard graph showing the relationship between the 28 days compressive strength of concrete mixes with different water-cement ratios and the 7 days compressive strength of cement tested in accordance with I.S.269.

It will be contractors sole responsibility to establish the concrete mix designs for different grades of concrete specified in the work consistent with the workability required for nature of work and also taking into consideration the assumed standard deviation which will be expected at site or by establishing the standard deviation based on 30 test results at site for each grade of concrete so as to produce concrete of required strength, durability and surface finish. The materials and proportions used in making the tests to be carried out either at site or under laboratory, conditions shall be similar in all respects to those to be actually employed in the works, as the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce the concrete of the required consistency to give such specified strength.

4.4.2. STANDARD DEVIATION:

The standard Deviation for each grade of concrete shal be calculated separately.

STANDARD DEVIATION BASED ON TEST RESULTS :

a) **Number of test results -** The total number of test results required to constitute and acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.

b) **Standard deviation to be brought up to date -** The calculation of the standard deviation shall be brought upto date after every change of mix design and at least once a month.

Determination of standard deviation :

i) Concrete of each grade shall be analysed separately to determine its standard deviation.

The standard deviation of concrete of a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample:

ii) Estimated standard ***deviation S*** = $\sqrt{\{ \Sigma \Delta^2 \div (n-1)\}}$

iii) Where Δ = Deviation of the individual test strength from the average strength of a sample and n = Number of sample test results.

iv) When significant changes are made in the production of concrete (for example changes in the materials used, mix design, equipments or technical control), the standard deviation value shall be separately calculated for such batches of concrete.

Assumed Standard Deviation:

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in table below may be assumed for design of mix in the first instance. As soon as the results of samples are available, actual calculated standard deviation shall be used and the mix designed properly. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in table below, it shall be permissible to use that value.

Grade of Concrete	Assumed Standard Deviation	N/ mm²
M 10 M 15	3.5	
M 20 M25	4.0	
M30 M35 M40	5.0	

Note: The above values correspond to the site control having proper storage of cement: weigh batching of all materials: controlled addition of water: regular checking of all materials: aggregate gradings and moisture contents : and periodical checking of workability: and strength. Where there is deviation from the above the values given in the above table shall be increased by 1 N / mm.^{2}

4.4.3. Proportioning, Consistency, Batching and Mixing of Concrete:

4.4.3.1. Proportioning :

Aggregate : The proportions which shall be decided by conducting preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weigh batchers conforming to I.S. 2722, capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of **properly** graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stacked in separate stock piles. The gradings of coarse and fine aggregates shall be checked as frequently as possible, as determined by the Engineer-in-Charge, to ensure maintaining of grading in accordance with samples used in preliminary mix design. The materials shall be stock piled well in advance of use.

Cement : The cement shall be measured by weight. Every facility should be provided to the Engineer-in-Charge for sampling and inspection of stored cement at site of work.

Exposure conditions: General environment:

S.No:	Environment	Exposure Conditions
(1)	(2)	(3)
i)	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
ii)	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet Concrete exposed to condensation and rain Concrete continuously under water
iii)	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation.
iv)	Very severe	Concrete surfaces exposed to seawater spray, corrosive fumes or severe freezing conditions whilst wet.
v)	Extreme	Surface of members in tidal zone Members in direct contact with liquid/solid aggressive chemicals.

WATER : Only such quantity of water shall be added to the cement and aggregate in the concrete mix as to ensure dense concrete, specified surface finish,

satisfactory workability, consistent with strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

Definition of water cement ratio :The water cement (W/C) ratio is defined as the weight of water in mix (including the surface moisture of the aggregates) divided by the weight of the cement in the mix.

Water cement ratio :The actual water cement ratio to be adopted shall be determined in each instance by contractor and approved by the Engineer-in-charge.

Proportioning by water-cement ratio :The W/C ratio specified for use by the Engineer-in-Charge shall be maintained. Contractor shall determine the water content of the aggregate as frequently as directed by the Engineerin-Charge as the work progresses and as specified in I.S. 2386 part III and the amount of mixing water added at the mixer shall be adjusted as directed by the Engineer-in-charge so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

4.4.3.2. Consistency and slump : Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests etc. in accordance with I.S. 1199, shall be conducted from time to time to ensure the maintenance of such consistency.

The following tabulation gives a range of workability which shall generally be used for various types of construction unless other wise instructed by the Engineer-in-Charge.

Workability of concrete :

Placing condition	Degree of	Slump
(1)	(2)	(3)
Blinding Concrete; Shallow Sections;	Very low	See note 1.
Mass concrete; Lightly reinforced Sections in slabs, Beams, walls, columns; Floors; Hand placed pavements; Canal lining;	Low	25-75
Heavily Reinforced sections In slabs, beams, walls, columns,	Medium	50-1 00 75-100

Trench fill, In-situ piling	High	100-1 50
Tremie Concrete	Very High	See note 2.

Note :

1. For most of the placing conditions, internal vibrators (needle vibrators) are suitable. The diameter of the needle shall be determined based on the density and spacing of reinforcement bars and thickness of sections. For tremie concrete, vibrators are not required to be used.

2. the 'very low' category of workability where strict control is necessary, for example pavement quality concrete, measurement of workability by determination of compacting factor will be more appropriate than slump (see IS 1199) and a value of compacting factor of 0.75 to 0.80 is suggested.

3. In the 'Very high' category of workability, measurement of workability by determination of flow will be appropriate (see IS 9103).

PRODUCTION OF CONCRETE:

QUALITY ASSURANCE MEASURES:

In order that the properties of the completed structure be consistent with the requirements and the assumptions made during the planning and the design, adequate quality assurance measures shall be taken. The construction should result in satisfactory strength, serviceability and long term durability so as to lower the overall life-cycle cost. Quality assurance in construction activity relates to proper design use of adequate materials and components to be supplied by the producers, proper workmanship in the execution of works by the contractor and ultimately proper care during the use of structure including timely maintenance and repair by the owner.

Quality assurance measures are both technical and organizational. Some common cases should be specified in a general Quality Assurance Plan which shall identify the key elements necessary to provide fitness of the structure and the means by which they are to be provided and measured with the overall purpose to provide confidence that the realized project will work satisfactorily in service fulfilling intended needs. The job of quality control and quality assurance would involve quality audit of both the inputs as well as the outputs. Inputs are in the form of materials for concrete; workmanship in all stages of batching, mixing, transportation; placing, compaction and curing; and the related plant, machinery and equipments; resulting in the output in the form of concrete in place. To ensure proper performance, it is necessary that each step in concreting which will be covered by the next step is inspected as the work proceeds.

Each party involved in the realization of a project should establish and implement a Quality Assurance Plan, for its participation the project. Suppliers and contractors activities shall be covered in the plan. The individual quality assurance plans shall fit into the general Quality Assurance Plan. A quality assurance plan shall define the tasks and responsibilities of all persons involved ,adequate control and checking procedures, and the organization maintaining

adequate documentation of building process and its results. Such documentation should generally include:

a) test reports and manufacturers certificate for materials, concrete mix design details;

b) pour cards for site organization and clearance for concrete placement;

c) record of site inspection of workmanship, field tests

d) non-conformance reports, change orders;

e) quality control charts;

f) statistical analysis.

NOTE – Quality control charts are recommended wherever the concrete is in continuous production over considerable period.

4.4.3.3. Batching and mixing of concrete :

BATCHING

To avoid confusion and error in batching, consideration should be given to using the smallest practical number of different concrete mixes on any site or in any one plant. In batching concrete, the quantity of both cement and aggregate shall be determined by mass; admixture, if solid, by mass; liquid admixture may however be measured in volume or mass; water shall be weighed or measured by volume in a calibrated tank (see also IS4925)

Ready mixed concrete supplied by ready-mixed concrete plant shall be preferred. For large and medium project sites the concrete shall be sourced from ready-mixed concrete plants or from on site or off site batching and mixing plants (see IS 4926)

Except where it can be shown to the satisfaction of the engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, the different sizes being stocked in separate stock – piles. The material should be stock-piled for several hours preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible , the frequency for a given job being determined by the engineer-in-charge to ensure that the specified grading is maintained.

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

Proportion / Type and grading of aggregate shall be made by trial in such a way so as to obtain densest possible concrete. All ingredients of the concrete should be used by mass only.

Volume batching may be allowed only where weigh-batching is not practical and provided accurate bulk densities of materials to be actually used in concrete have earlier been established. Allowance for bulking shall be made in accordance with IS 2386 (Part 3). The mass volume relationship should be checked as frequently as necessary, the frequency for the given job being determined by engineer-in-charge to ensure that the specified grading is maintained.

It is important to maintain the water-cement ratio constant at its correct value. To this end determination of moisture contents in both fine and coarse aggregates shall be made as frequently as possible the frequency for a given job being determined by the engineer-in-charge according to weather conditions. The amount of the added water shall be adjusted to compensate for any observed variations in the moisture content. For the determination of moisture content in the aggregates IS 2386 (Part 3) may be referred to. To allow for the variation in mass of aggregate due to variation in their moisture content, suitable adjustments in the masses of aggregates shall also be made. In the absence of exact data only in the case of nominal mixes the amount of surface water may be estimated from the values given in table below.

Surface water carried by aggregate

Sr. No.	**Aggregate**	**Approximate quantity of surface water**	
		Percent by	**l/m³**
(1)	(2)	(3)	(4)
i)	Very wet sand	7.5	120
ii)	Moderately wet sand	5.0	80
iii)	Moist sand	2.5	40
iv)	Moist gravel or crushed rock	1.25 –2.5	20 – 40
	Coarser aggregate less the water it		

No substitutions in materials used on the work or alterations in the established propositions except as permitted as above shall be made without additional tests to show that the quality and strength of concrete are satisfactory.

MIXING:

Concrete shall be mixed in a mechanical mixer. The mixer should with IS 1791 and IS 12119. The mixers shall be fitted with water measuring (metering) devices. The mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete should be remixed.

For guidance, the mixing time shall be at least 2 min. For other types of more efficient mixers, manufacturers recommendations shall be followed; for hydrophobic cement it maybe decided by the Engineer-in-Charge.

Workability should be checked at frequent intervals.

Dosage of retards, plasticisers and superplsticisors shall be restricted to 0.50,1.0 and 2.0 % respectively by weight of cementecious materials and unless higher

value is agreed upon between the manufacturer and constructor based on performance test.

Each time the work stops, the mixer shall be cleaned out and when next commencing the mixing, the first batch shall have 10% additional cement to allow for sticking in the drum.

4.5. SAMPLING AND TESTING CONCRETE IN THE FIELD: Facilities required for sampling materials and concrete in the field, if Engineer-in-Charge so desires, shall be provided by contractor at no extra cost. The following equipment with operator shall be made available at Engineers request (all must be in serviceable condition):

1.	Cast iron cube moulds 15 cm. Size	12 Nos.(min.)
2.	Slump cone complete with tamping rod	1 Set
3.	Lab. balance to weigh upto 5 kg. with sensitivity of	1 No.
4.	Laboratory balance of 2 kg. capacity and of sensitivity	1 No.
5.	I.S. sieves for coarse and fine aggregates.	1 Set
6.	A set of measures from 5 ltrs. to 0.1 ltr.	1 Set
7.	Electric oven with thermostat upto 120 0C.	1 No.
8.	Pycnometer	1 No.
9.	Calibrated glass jar 1 ltr. Capacity	2 Nos.
10	Glass flasks and metal containers	As required
11	Concrete cube testing machine (optional)	1 No.

4.6. TESTING : Different tests required to be carried out for concrete works including the mix design, cube tested as per the above specifications shall be got done by the contractor at his own cost in one of the approved laboratories. **The choice of Approved Testing laboratory shall rest with MDL.** All incidental charges / cost shall be borne by the contractor. All test as per Bureau of Indian standard code.

The contractor has to arrange to transport all the materials, cubes etc. to be tested, to the laboratory at his own cost.

4.7. SAMPLING AND STRENGTH TEST OF CONCRETE:

Samples from fresh concrete shal be taken as per I.S. 1199 and cubes shal be made, cured and tested at 28 days in accordance with *I.S. 516 .*

In order to get a relatively quicker idea of the quality of concrete, option tests on beams for modulus of rupture at 72 (+/-) 2 hours or at 7 days or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values given in table below may be taken for general guidance in the case of concrete made with ordinary cement. In all cases, the 28 days compressive strength specified shall alone be the criterion for acceptance or rejection of the concrete. If however, from test carried out in particular job over a reasonably long period, it has been established to the satisfaction of the Engineer-in-Charge that a suitable ratio between 28 days compressive strength and modulus of rupture at 72 (+/-) 2 hours or 7 days or

compressive strength at 7 days may be accepted, the Engineer-in-Charge may suitably relax the frequency of 28 days compressive strength, provided the expected strength values at the specified early age are consistently met.

Optional Tests Requirements of Concrete:

Grade of Concrete	**Compressive strength on 15 cm cubes min. at 7 days**	**Modulus of rupture by beam**	
		At 72 (+/-) 2	**At 7 days**
		N / mm²	**N / mm2**
M 10	7.0	1.2	1.7
M 15	10.0	1.5	2.1
M 20	13.5	1.7	2.4
M 25	17.0	1.9	2.7
M 30	20.0	2.1	3.0
M 35	23.5	2.3	3.2
M 40	27.0	2.5	3.4

4.7.2. Frequency of Sampling :

Sampling Procedure : A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested, i.e. the sampling should be spread over the entire period of concreting and cover all mixing units.

Frequency : The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of concrete in the work (in cum.)	**Number of samples**
1-5	1
6-15	2
16-30	3
31-50	4
51 and above	4 plus one additional for each additional

At least one sample shall be taken from each shift. Where concrete is continuous production unit, such as ready - mixed concrete plant, frequency of sampling may be agreed upon mutually by suppliers and purchasers.

4.7.3. Test Specimen : Three test specimen shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7days or at the time of striking the form work or to determine the duration of curing or to check the testing error. Additional cubes may also be required for testing cubes cured by accelerated methods as described in I.S. 9013 - 1978. The specimen shall be tested as described in I.S. 516 - 1959.

4.7.4. Test Strength of Samples : The test strength of the samples shall be the average of the strength of three specimen. The individual variation should not be more than (+/-) 15 percent of the average.

4.7.5. Consistency : Slump test shall be carried out as often as demanded by the Engineer-in-Charge and invariably from the same batch of concrete from which the test cubes are made. Slump tests shall be done immediately after sampling.

4.7.6. Standard Deviation : Vide clause 4.4.2 of this specification.

4.8. ACCEPTANCE CRITERIA :

The concrete shall be deemed to comply with the strength requirements when both the following conditions are met:

(a) The mean strength determined from any group of four consecutive test results complies with the appropriate limits in column 2 of Table below

(b) Any individual test result complies with the appropriate limits in column of Table below.

Characteristic Compressive Strength Compliance Rquirement:

Specified grade	**Mean of the Group of 4 Non-overlapping**	**Individual test results in N/mm²**
(1)	**(2)**	**(3)**
M 15	= / > f_{ck}+ 0.825 x	
	standard deviation (rounded off	= / >fck –3 N/ mm²
	0.5 N/mm²	
	or = / > f_{ck} + 3 N / mm²	
M 20 Or Above	= / > > f_{ck} + 0.825 x established standard deviation (rounded off to nearest 0.5 N/ mm²	= / > fck – 4 N / mm²

Note – In the absence of established value of standard deviation, the values given in (assumed standard deviation) may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

Flexural Strength

When both the following conditions are met, the concrete complies with the specified flexural strength.

(a) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2

(b) The strength determined from any test result is not less than the specified characteristic strength less 0.3N/mm^2

Quantity of Concrete Represented by Strength Test Results.

The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

For the individual test result requirements given in column 2 of above table or in item (b) of flexural strength, only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to $60m^3$

If the concrete is deemed not to comply pursuant to above the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.

Concrete of each grade shall be assessed separately

Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-Charge.

4.9. ADMIXTURES :

Admixtures, if used shall comply with IS 9103. Previous experience with and data on such materials should be considered in relation to the likely standards of supervision & workmanship to the work being specified. Admixtures should not impair durability of the concrete not combined with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

The workability, compressive strength and the slump loss of concrete with & without the use of admixtures shall be established during the trial mixes before use of admixtures.

The relative density of liquid admixtures shall be checked for such drum containing admixtures and compared with the specified value before acceptance.

The chloride content of the admixtures shall be independently tested for each batch before acceptance. If two or more admixtures are used simultaneously in the same concrete mix data should be obtained to assess their interaction and to ensure their compatibility.

General :

Admixture may be used in concrete only with the approval of Engineer-in-charge based upon evidence that, with the passage of time neither the compressive strength nor its durability reduced. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturers instructions and in the manner and with the control specified by Engineer-in-Charge.

i) **Calcium Chloride :** Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1 .5 percent of the weight of cement in each batch of concrete.

ii) **Air Entraining Agents :** Where specified and approved by Engineer-in-charge, neutralized vinsol resin or any other approved air entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6.260, Air Entraining admixtures for concrete. The recommended total air content of the concrete is 4% (+/-) 1%. The method of measuring air content shall be as per I.S.1199.

iii) **Retarding Admixtures :** Where specified and approved by Engineer-in-Charge, retarding agents shall be added to the concrete mix in quantities specified by Engineer-in-Charge.

iv) **Water Reducing Admixtures :** Where specified and approved by Engineer-in-Charge, water reducing lignosulfonate mixture shall be added in quantities specified by Engineer-in-Charge. The admixtures shall be added in the form of a solution.

v) **Water Proofing Agents :** Where specified and approved by Engineer-in-Charge, chloride and sulphate free water proofing agents shall be added in quantities specified by Engineer-in-Charge.

vi) **Other Admixtures :** Engineer-in-Charge may at his discretion, instruct contractor to use any other admixture in the concrete.

4.10. INSPECTION OF STRUCTURES :

Immediately after stripping the form work, all concrete shall be carefully inspected and any defective work or small defects, either removed or made good before concrete has thoroughly hardened, as instructed by Engineer-in-Charge.

In case of doubt regarding the grade of concrete used or results of cube strength are observed to be lower than the designed strength as per specifications at 28 days, compressive strength test of concrete based on core test, ultrasonic test and/or load test shall be carried out by the digital ultrasonic concrete tester by an approved agency as directed by the Engineer-in-Charge all at the cost of the contractor. In case these tests do not satisfy the requirements, the E.I.C will be at liberty to reject the concrete, and the contractor, at his own cost, has to dismantle and re-do the same or carry out such remedial measures as approved by the E.I.C.

4.11. TESTING OF STRUCTURES :

4.11.1. Optional Tests : Engineer-in-charge, if he so desires, may order for tests to be carried out on cement, sand, coarse aggregate, water etc. in accordance with the relevant Indian Standards.

Tests on cement will be carried out by the Contractor from approved lab and shall include (i) fineness test, (ii) test for normal consistency, (iii) test for setting time, (iv) test for soundness, (v) test for compressive strength, (vi) test for heat of hydration (by experiment and by calculations) in accordance with I.S.269.

Tests on sand shall include (i) sieve test, (ii) test for organic impurities, (iii) decantation test for determining clay and silt content, (iv) specific gravity test, (v) test for unit weight and bulkage factor, (vi) test for sieve analysis and fineness modulus.

Tests on coarse aggregate shall include (i) sieve analysis, (ii) specific gravity and unit weight of dry, loose and rodded aggregate, (iii) soundness and alkali aggregate reactivity, (iv) petrographic examination, (v) deleterious materials and organic impurities, (vi) test for aggregate crushing value.

The test on aggregates would normally be ordered to be carried out only if Engineer-in-charge feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at an approved test laboratory. Contractor shall have to pay all the charges of optional tests. If the work cubes do not give the stipulated strengths, Engineer-in-Charge reserves the right to ask contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standards stipulated at contractors cost.

The unit rate for concrete shall be all inclusive including making preliminary mix design and test cubes, works cubes, testing them as per specifications, slump tests, optional tests etc. Complete. The contractor will have to make arrangements for transportation to the laboratory and testing charges will be borne by the contractor.

The contractor should also conduct **conclusive tests** such as ultrasonic pulse test, core test etc. to prove the suitability of concrete, in case cube tests give

unsatisfactory results. The cost of the conclusive test should be borne by the contractor.

4.11.2. Core Test : The points from which cores are to be taken and the number of cores required, shall be at the discretion of the Engineer-in-Charge and shall be representative of the whole of concrete concerned.

In no case, however, shall fewer than three cores be tested. Cores shall be prepared and tested as described in I.S. 516

4.11.3. Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85% of the cube strength of the grade of concrete specified for the corresponding age and no individual core has a strength less than 75%.

In case the core test results do not satisfy the requirements as above or where such tests have not been done, load test (see 4:11:3) may be resorted to.

4.11.4. LOAD TESTS ON PARTS OF STRUCTURE :

Load tests should be carried out as soon as possible after expiry of 28 days from the time of placing of concrete.

The structure should be subjected to a load equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24 hours and then the imposed load shall be removed.

Note: Dead load includes weight of the structural members plus weight of finishes and walls or partitions, if any, as considered in the design.

The deflection due to imposed load only shall be recorded. If within 24 hours of removal of the imposed load, the structure does not recover at least 75% of the deflection under super imposed load, the test may be repeated after a lapse of 72 hours. If the recovery is less than 80%, the structure shall be deemed to be unacceptable.

If the maximum deflection in mm. shown during 24 hours under load is less than $40L^2/D$, where L is the effective span in M. and D the overall depth of the section in mm, it is not necessary for recovery to be measured and the recovery provision as above will not apply.

4.11.5. Other non-destructive test methods may be adopted, in which case the acceptance criteria shall be agreed upon between the Engineer-in-Charge and the Contractor and the test shall be done under expert guidance.

MEMBERS OTHER THAN FLEXURAL MEMBERS:

Members other than flexural members should be preferably investigated by analysis.

Non – destructive tests:

Non-destructive tests are used to obtain estimation of properties of concrete in the structure. The methods adopted include ultrasonic pulse velocity [see IS 13311 (Part 1)] and rebound hammer [IS 13311 (Part 2)], probe penetration, pull out and maturity. Non destructive tests provide alternatives to core tests for estimating the strength of concrete in a structure, or can supplement the data obtained from a limited number of cores. These methods are based on measuring a concrete property that bears some relationship to strength/ the accuracy of these methods, in part is determined by the degree of correlation between strength and the physical quality measured by the non-destructive tests.

Any of these methods may be adopted, in which case the acceptance criteria shall be agreed upon prior to testing.

4.11.6. TESTING OF UNDERGROUND WATER TANK/SEPTIC TANK/UNDERGROUND STRUCTURES :

The tank will be tested after the completion according to the procedure laid down here:

The middle compartment shall be filled first to its full height and the leakage if any shall be checked on its outer surfaces and if found, the same shall be examined carefully and defects rectified/grouted if necessary. The drop in level of surface of water shall also be recorded for 48 hours. If this drop in level exceeds 20 mm. and shows any leakage in the said walls, necessary steps shall be taken in consultation with the Engineer-in-Charge.

After this compartment is tested to the satisfaction of the Engineer-in-Charge, all water from middle compartment shall be pumped into side compartment to the full height and checked for water leakages from the outer surfaces of the tank as well as inner surface of the middle compartment. The drop in level of surface of water shall also be checked as stated above and defects rectified.

The external surface of the tank shall then be plastered and cured as per the specifications and back filling shall be taken up thereafter. The water from the compartments shall then be pumped out and the inner surface of the tank in all compartments then be checked and defects rectified.

After satisfactory completion of checks, internal plaster shall be taken up as specified in the specifications.

The contractor shall be responsible for carrying out the complete test, rectifying the leakages if any. The cost of providing all equipments, labour for carrying out tests shall be borned by the contractor. The rates quoted for concreting items for constructing under ground water tank shall be inclusive of testing of RCC tank for water tightness as per above specifications. The contractor shall make his own arrangement to tap the water as per the contract . If supply of water not stipulated under Schedule 'A', the contractor shall make his own arrangement as per contract conditions at his own cost.

4.11.7. UNSATISFACTORY TESTS :

Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction, contractor shall remove and rebuild the member or members involved or carry out such other remedial measures as may be required by Engineer-in-Charge. Contractor shall bear the cost of so doing, unless the failure of the member or members to fulfill the test conditions is proved to be solely due to faulty design. The cost of load and other tests shall be borne by Contractor.

4.12. CONCRETE IN ALKALI SOILS WATER & AGGREGATES:

Some aggregates containing particular varieties of silica may be susceptible to attack by alkalis (Na20 and K20) originating from cement and other sources, producing an expansive reaction which can cause cracking and disruption of concrete. Damage to concrete from this reaction will normally only occur when all the following are present together.

a) A high moisture level, within the concrete.

b) A cement with high alkali content, or another source of alkali;

c) Aggregate containing an alkali reactive constituent.

Where the service records of particular cement / aggregate combination are well established, and do not include any instances of cracking due to alkali-aggregate reaction, no further precautions should be necessary. When the materials are unfamiliar, precautions should take one or more of the following forms:

a) Use of non-reactive aggregate from alternate sources

b) Use of low alkali ordinary Portland cement having total alkali content not more than 0.6 percent (as Na2O equivalent).

Further advantage can be obtained by use of fly ash (Grade I) conforming to IS 381 2or granulated blast furnace slag conforming to IS 12089 as part replacement of ordinary Portland cement (having total alkali content as Na2O equivalent not more than 0.6 percent) provided fly ash content is at least 20 % or slag content is at least 50 percent.

a) Measures to reduce the degree of saturation of the concrete during service such as use of impermeable membranes

b) Limiting the cement content in the concrete mix and thereby limiting total alkali content in the concrete mix as per approval of Engineer- in-charge.

Chlorides in the concrete

Whenever there is chlorides in concrete there is an increased risk of corrosion of embedded metal. The higher the chloride content or if subsequently exposed to warm moist conditions, the greater the risk of corrosion. All constituents may contain chlorides and concrete may be contaminated by chlorides from the external environment. To minimise the chance of deterioration of concrete from harmful chemical salts, the levels of such harmful salts in concrete materials, that is, cement, aggregates, water and admixtures, as well as by diffusion from the

environment should be limited. The total amount of chloride content (as Cl) in the concrete at the time of placing shall be as given below in the table.

Limits of Chloride Content of Concrete

Sl. No	Type or Use of Concrete	Maximum Total Acid soluble Chloride Content Expressed as
(1)	(2)	(3)
i)	Concrete containing metal and steam cured at	0.4
ii)	Reinforced concrete or plain concrete containing	0.6
iii)	Concrete not containing embedded metal or any	3.0

The total acid soluble chloride content should be calculated from the mix proportions and the major chloride contents of each of the constituents. Whenever possible the total chloride content of the concrete should be determined as per the approval of the Engineer-in-Charge.

Sulphates in concrete:

Sulphates are present in most cements and in some aggregates; excessive amounts of water-soluble sulphate from these or other mix constituents can cause expansion and disruption of concrete. To prevent this, the total water-soluble sulphate content of the concrete mix, expressed as SO3, should not exceed 4 per cent by mass of the cement in the mix. The sulphate content should be calculated as the total from the various constituents of the mix as per the approval of the Engineer-in-Charge.

The 4 percent limit does not applied to concrete made with super sulphated cment complying with IS 6909 or as approved by the Engineer-in-Charge.

4.13. PREPARATION PRIOR TO CONCRETE PLACEMENT, FINAL INSPECTION & APPROVAL :

Before the concrete is actually placed in position, the inside of the form work shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and wall forms, to permit removal of saw dust, wood shavings, binding wire, rubbish, dirt etc. Opening shall be placed or holes drilled so that these materials and water can be removed easily. Such openings / holes shall be later suitably plugged.

The various traders shall be permitted ample time to install drainage and plumbing lines, floor and trench drain, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be cast in the concrete as indicated on the drawing or as necessary for the proper execution of the work. All such embedments shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

Slots, openings, holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by the Engineer-in-Charge.

Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.

Prior to concrete placement, all works shall be inspected and approved by Engineer-in-Charge, and if found unsatisfactory, concrete shall not be poured until all defects have been corrected at contractors cost.

Approval by Engineer-in-Charge of any and all materials and work as required herein shall not relieve contractor from his obligations to produce finished concrete in accordance with the drawings and specifications.

4.13.1. RAIN OR WASH WATER :

No concrete shall be placed in wet weather or on a water covered surface. Any concrete that has been washed by heavy rain shall be entirely removed,if there is any sign of cement and sand having been washed from the concrete mixture. To guard against damage which may be caused by rain, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted before leaving the work unattended. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitable drains and sumps shall be provided.

4.13.2. BONDING MORTAR :

Immediately before concrete placement begins, prepared surfaces, except form work, which will come in contact with concrete to be placed, shall be covered with a bonding mortar of same strength of concrete.

4.13.3. TRANSPORTATION :

All buckets, containers or conveyers used for transporting concrete shall be mortar-tight. All means of conveyance shall be adopted to deliver concrete of the required consistency and plasticity without segregation or loss of slump whatever method of transportation is employed. Chute shall not be used to transport the concrete without the written permission of the Engineer-in-Charge and concrete shall not be rehandled before placing.

4.13.4. Retempered or Contaminated Concrete :

Concrete must be placed in its final position before it becomes too stiff to work. On no account water shall be added after the initial mixing. Concrete which has become stiff or has been contaminated with foreign materials and which has not been placed within half an hour of mixing water with cement shall be rejected.

4.13.5. CLEANING OF EQUIPMENT :

All equipments used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipe lines and other equipments shall be thoroughly cleaned after each period of placement.

4.13.6. PROCEDURE FOR PLACING OF CONCRETE :

1. **Engineers Approval of Equipment and Methods :** Before any concrete is placed, the entire placing programme, consisting of equipment, layout proposed procedures and methods shall be submitted to Engineer-in-Charge and no concrete shall be of such size and design to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.

2. **Time Interval Between Mixing and Placing :** Concrete shall be placed in its final position before the cement reaches its initial set and concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.

3. **Avoiding Segregation :** Concrete shall in all the cases be deposited as nearly as practicable directly in its final position and shall not be rehandled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, contractor shall provide suitable prop and Elephant Trunks to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way, particularly in columns and thin walls.

4. **Placing by Manual Labour :** Except when otherwise approved by Engineer-in-Charge, concrete shall be placed in the shuttering by shovels or other approved implements and shall not be dropped from a height more than 1.0 m. or handle in a manner which will cause segregation.

5. **Placing by Mechanical Equipment :** The following specifications shall apply when placing of concrete by sue of mechanical equipment is specially called for while inviting bids or is warranted, considering the nature of work involved.

   The control of placing shall begin at the mixer discharge. Concrete shall be discharged by a vertical drop into the middle of the bucket of hopper and this principle of a vertical discharge of concrete shall be adhered-to through out all stages of delivery until the concrete comes to rest in its final position.

   Type of buckets : All concrete shall be conveyed from the mixer to the place of final deposit in suitable buckets, dumpers, containers which shall be leak-tight. All means of conveyance shall be adopted for delivering concrete to the required consistency/ workability and plasticity without segregation.

   Central bottom dump buckets of a type that provides for positive regulation of the amount and rate deposition of concrete in all dumping position shall be employed.

   Operation of Bucket : In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop

shall not exceed 1.0 m. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

6. **Placement in Restricted Forms :** Concrete placed in restricted forms by borrows, buggies, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

7. **Chutting :** Where it is necessary to use transfer chutes, specific approval of Engineer-in-Charge must be obtained to type, length, slopes, baffles, vertical terminal and timing of operations. These shall be so arranged that almost continuous flow of concrete is obtained at the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the waste water shall be kept clear of the forms. The concrete shall not be permitted to fall from the end of the chutes by more than 1.0 m. Chutes, when approved for use, shall have slopes not flatter than 1 vertical to 3 horizontal and not steeper than 1 vertical to 2 horizontal, chutes shall be of metal or metal line and of rounded cross section. The slopes of all chute sections shall be approximately same. The discharge end of the chutes shall be maintained above the surfaces of the concrete in the forms.

8. **Placing by Pumping/ Pneumatic Placers :** Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers, only with the written permission of Engineer-in-Charge. The slump shall be held to the minimum, necessary for conveying concrete by this method.

   When pumping is adopted, before pumping of concrete is started, the pipelines shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

   When pneumatic placer is used, the manufacturers advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at the end.

   Manufacturers advice shall be followed regarding concrete quality and all other related matters when pumping/ pneumatic placing equipments are used.

9. **Concrete in Layers :** Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 cm. to 90 cm. as directed by Engineer-in-Charge. These shall be placed as rapidly as practicable to prevent the formation of cold joints or planes of weakness between each succeeding layers within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit, shall spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum of shovelling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer-in-

Charge.

Bedding of Layers : The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed.

COMPACTION :

4.13.7. COMPACTION : Concrete shall be compacted during placing, with approved vibrating equipment, until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the form faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution is to be exercised not to over vibrate the concrete to the point of segregation.

1. **Type of Vibrators :** Vibrators shall conform to I.S. specifications. Type of vibrators to be used shall depend upon the structure where concrete is to be placed. Shutter vibrators, to be effective, shall be firmly secured to the form work which must be sufficiently rigid to transmit the vibrations and strong enough not to be damaged by it. Immersion vibrators shall have No load frequency amplitude and acceleration as per I.S.2505 depending on the size of the vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

2. **Use of Vibrators :** The exact manner application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm. apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of lift, e.g. in a column or wall.

3. **Melding successive batches :** When placing concrete in layers, which are advancing horizontally as the work progress, great care shall be exercised to ensure adequate vibration, blending and melding of the concrete between the successive layers.

4. **Penetration of vibrators :** The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

5. **Vibrating against reinforcement :** Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

6. **Use of Form Attached Vibrators :** Form attached vibrators shall be used only

with specific authorisation of Engineer-in-Charge.

7. **Use of surface vibrators :** The use of surface vibrators will not be permitted under normal conditions. However, for thin slabs, such as highways, runways and similar construction, surface vibrations by specifically designed vibrators may be permitted, upon approval of Engineer-in-Charge.

4.13.8. STONE POCKETS AND MORTAR PONDAGES : Formation of stone pockets or mortar pondages in corners and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to a sufficient depth and shape for thorough bounding as directed by Engineer-in-Charge.

4.13.9. PLACEMENT INTERVAL : Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete and before the start of a subsequent placement.

1. **Special Provision in Placing :** When placing concrete in walls with openings, in floors of integral slab and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls or bottom horizontal surface of the slabs as the case may be. Placing shall be resumed before the concrete in place takes initial set, but not until it has had time to settle as determined by Engineerin-charge.

2. **Placing Concrete Through Reinforcing Steel :** While placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregate. Where the congregation of steel make placing difficult, it may be necessary to temporarily move the top steel aside to get proper placement and restore reinforcing steel to design position.

4.13.10. BLEEDING : Bleeding or free water on top of concrete being deposited in to the forms, shall be caused to stop the concrete pour and the conditions causing this defect corrected before any further concreting is resumed.

4.14. CONSTRUCTION JOINTS AND KEYS :

Concrete shall be placed without interruption until completion of the part of the work between predetermined construction joints, as specified therein after. Time lapse between the pouring of adjoining units shall be as specified in the drawings or as directed by Engineer-in-Charge.

Construction joints and cold joints:

Joints are a common source of weakness and therefore it is desirable to avoid them. If this is not possible, their number shall be minimized . Concreting shall be carried out continuously up to construction joints the position and arrangement of which shall be indicated by the designer. Construction joints should comply with IS 11817.

Construction joints shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete, in order to create rough/uneven surface . It is recommended to clean out laitance and cement slurry by using wire

brush on the surface of joint immediately after initial setting of concrete and to clean at the same immediately thereafter. The prepared surface should be in a clean saturated surface dry condition when fresh concrete is placed, against it. In the case of construction joints at locations where the previous pour has been cast against shuttering the recommended method of obtaining a rough surface for the previously poured concrete is to expose the aggregate with a high pressure water jet or any other appropriate means.

Fresh concrete should be thoroughly vibrated near construction joints so that mortar from the new concrete flows between large aggregates and develop proper bond with old concrete.

Where high shear resistance is required at the construction joints, shear keys may be provided.

Sprayed curing membranes and release agent s should be thoroughly removed from joint surfaces.

If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made where the work is stopped. Joints shall be either vertical or horizontal, unless shown otherwise in drawing. In case of an inclined or curved member, the joints shall be at right angles to the axis of the member. Vertical joints in walls shall be kept to a minimum. Vertical joints shall be formed against a stop board, horizontal joints shall be level and wherever possible, arranged, so that the joint lines coincide with the architectural features of the finished work. Battens, shall be nailed to the form work to ensure a horizontal line and if directed, shall also be used to form a grooved joint. For tank walls, similar work joints shall be formed as per I.S. 3370. Concrete that is in the process of setting shall not be disturbed or shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and shear keys shall be located and shall conform in detail to the requirements of the plans unless otherwise directed by Engineer-in-Charge. Where not described, the joints shall be in accordance with the following:

1. **Column Joints :** In a column, the joint shall be formed 75 mm. below the lowest soffit of the beams including haunches if any. In flat slab construction the joint shall be 75 mm. below the soffit of column capital. At least 2 hours shall elapse after depositing concrete in column, piers or walls, before depositing in beams, girders or slabs supported thereon.

2. **Beam and Slab Joints :** Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and at the centre or within the middle third of the span unless otherwise shown in drawing. Where a beam intersects a girder, the joints in the girder shall be offset a distance equal to twice the width of the beam and additional reinforcement provided for shear. The joints shall be vertical throughout the full thickness of the concrete member. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidable at right angles to the principle reinforcement, the joint shall be vertical and at the middle of span.

3. **Joints in Liquid Retaining Structures :** Vertical construction joints in watertight construction will not be permitted unless indicated on the drawings.

Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of its construction to ensure maximum watertightness.

4. **Dowels :** Dowels for concrete work, not likely to be taken up in the near future, shall be wrapped in tar paper and burlap.

5. **Mass Foundations :** Mass foundations shall be poured in lifts not exceeding 1.5 m. in height unless, otherwise indicated on the drawings and approved by Engineer-in-Charge.

6. **Treatment of Construction Joints on Resuming Concreting :** Drier shall be used for the top lift or horizontal pours to avoid a laitance. All laitance and loose stones shall be thoroughly and carefully removed by wire brushing/ hacking and surface washed.

   Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned and loose matter removed and then treated with a thin layer of cement grout of proportion specified by Engineer-in-Charge and worked well into the surface. The new concrete shall be well worked specially against the prepared face before the grout mortar sets. Special care shall be taken to obtain thorough compaction and to avoid segregation of the concrete along the joint plane.

4.15. CURING, PROTECTING, REPAIRING, AND FINISHING:

1. **Curing :** All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water, continuously saturated covering of sacking, canvas, hessain or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

   Certain types of finish or preparation for overlaying concrete must be done at certain stages of curing process and special treatment may be required for specific concrete surface finish.

   Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Engineer-in-Charge.

1. **Curing with Water :** Fresh concrete shall be kept continuously wet for a minimum period of 14 days from the date of placing of concrete, following a lapse of 12 to 24 hours after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied to unformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

2. **Continuous Spraying :** Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances of hose sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer-in-Charge.

3. **Alternate Curing Methods :** Whenever in the judgment of Engineer-in-Charge, it may be necessary to omit the continuous spray method, covering of clean sand or other approved means such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. Any type of covering which would stain or damage the concrete during or after the curing period, will not be permitted. Covering shall be kept continuously wet during the curing period.

   For curing of concrete in pavements, side-walks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer-in-Charge. Special attention shall be given to edges and corners of the slab to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the curing period.

4. **Curing Compounds :** Surface coating type curing compound shall be used only on special permission of Engineer-in-Charge. Curing compounds shall be liquid type while pigmented, conforming to U.S. Bureau of Reclamation Specification. No curing compound shall be used on surface where future blending with concrete, water or acid proof membrane or painting is specified.

5. **Curing Equipment :** All equipments and materials required for curing shall be on hand and ready for use before concrete is placed.

6. **Moist Curing:** Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking , canvas, hassian or similar materials and kept constantly wet for at least seven days from the date of placing concrete. In case of ordinary Portland cement and at least ten days where mineral admixtures or blended cement are used. The period of curing shall not be less than ten days of concrete exposed to dry and hot wheather conditions. In the case of concrete the mineral admixtures or blended cement are used, it is recommended that the above minimum periods may be extended to fourteen days as per the approval of the Engineer-in-Charge.

7. **Membrane Curing:** Approved curing compounds may be used in lieu of moist curing with the permission of Engineer-in-charge. Such compounds shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set. Impermeable membranes such as poly ethylene sheeting covering, closely the concrete surface may also be used to provide effective barrier against evaporation.

   For the concrete containing Portland pozzolona cement, Portland slag cement or mineral admixtures increased period of curing may be decided by Engineer-in-charge.

   The rate of strength development at early age of concrete made with super sulphated cement is significantly reduced at lower temperatures. Super sulphated cement concrete is seriously affected by inadequate curing and the surface has to

be kept moist for at least seven days or more as per the approval of the Engineer-in-Charge.

4.16. PROTECTING FRESH CONCRETE :

Fresh concrete shall be protected from the elements, from defacements and damage due to construction operations by leaving forms in place for ample period as specified later in this specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by Engineer-in-Charge, shall also be taken to protect immature concrete from damage by debris, excessive loading, vibrations, abrasion or contact with other materials etc. that may be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, Engineer-in-Charge may require that bridges be placed over the area.

4.17. REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE :

Immediately after the shuttering is removed, the surface of concrete shall be very carefully gone over and all defective areas called to the attention of Engineer-in-Charge who may permit patching of the defective areas or else reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by Contractor at no additional expense. Holes left by form bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing through 2.36 mm. I.S. sieve after removing any loose stones adhering to the concrete. Mortar filling shall be struck off flush at the face of the concrete. Concrete surface shall be finished as described under the particular item of work.

Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of Engineer-in-Charge and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer-in-Charge, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities, care being taken to avoid damaging the surfaces. Surface irregularities shall be removed by grinding.

If reinforcement is exposes or the honey combing occurs at vulnerable position e.g. ends of beams or columns, it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer-in-Charge shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25 mm.), the edges being cut perpendicular to the affected surface or with a small under cut if possible, anchors, tees or dowels shall be provided in slots whenever necessary to attach the new concrete securely in place. An area extending several centimetres beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

1. **Use of Epoxy :** The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer-in-Charge. Epoxies shall be applied in strict accordance with the instruction of the manufacturer.

2. **Method of Repair :** Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows:

   The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

   A 5 mm. thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched followed immediately by the patching concrete which shall be well consolidated with a wooden float and left slightly proud of the surrounding surface. The concrete patch shall be built up in 10 mm. thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and a smooth finish obtained by wiping with hessian. Steel trowel shall not be used for this purpose. The mix for patching shall be of the same materials and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

   Mortar filling by air pressure (guniting) shall be used for repair of areas to large and/ or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Engineering-in-Charge, to match the shade of the patch with the original concrete.

3. **Curing of Patched Work :** The patched area shall be covered immediately with an approved non-staining water-saturated material such as gunny bags, which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray of sprinkling water for not less than 10 days.

4. **Approval by Engineer-in-Charge :** All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Engineer-in-Charge. All fillings shall tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.

4.18. FINISHING :

This specification is intended to cover the treatment of concrete surfaces of all structures.

1. **Finish for Formed Surfaces :** The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified by the Engineer in charge:

   For surfaces against which backfill or concrete is to be placed, no treatment is required except repair of defective areas.

   For surfaces below grade, which will receive waterproofing treatment, the concrete shall be free of surface irregularities which would interfere with proper application of the water-proofing materials which is specified for use.

Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of fins and abrupt irregularities, filling of holes left by form ties and rods and clean up of loose or adhering debris.

Surfaces which will be exposed to the weather and which would normally be levelled, shall be sloped for drainage. Unless the drawing specify a horizontal surface or shows the slope required, the tops of narrow surfaces such as staircase treads, walls, curbs and parapets shall be sloped across the width approx. as 1 in 30. Broader surfaces such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, sub floors to be covered with concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth, screeded and leveled to produce even surfaces. Surface irregularities shall not exceed 6mm. Surfaces which will not be covered by backfill, concrete or tile topping such as outside decks, floors of galleries and sumps, parapets, gutters, sidewalks, floors and slabs shall be consolidated, screeded and floated.

Excess water and laitance shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screeded surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints and edges shall be tooled as called for on the drawings or as directed By Engineer-in-Charge.

2. **Standard Finish for Exposed Concrete :** Exposed concrete shall mean any concrete other than floors or slabs exposed to view upon completion of the job. Unless otherwise specified on the drawings, the standard finish for exposed concrete shall be of smooth finish.

   A smooth finish shall be obtained with use of lined or plywood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms, the joint marks shall be smoothed off and all blemishes, projections etc. removed, leaving the surfaces reasonably smooth and unmarred.

3. **Integral Cement Concrete Finish :** When specified on the drawings, an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified in the drawings and as per I.S.2571. The surface shall be compacted and then floated with a wooden float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

4. **Rubbed Finish :** A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, off sets leveled and voids and/ or damaged sections immediately saturated with water and repaired by filling with concrete or mortar of the same composition as was used in the

surfaces. The surfaces shall then be thoroughly wetted and rubbed with carborandum or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

4.19. PROTECTION :

All concrete shall be protected against damage until final acceptance by Engineer-in-Charge.

4.20. FOUNDATION BEDDING, BONDING AND JOINTING :

All surfaces upon or against which concrete will be placed shall be suitably prepared by thoroughly cleaning, washing and dewatering as may be indicated in the plans or as Engineer-in-Charge may direct to meet the various situations encountered in the work.

Soft or spongy areas shall be cleaned out and back filled with either a soil cement mixture, lean concrete or clean sand fill compacted to minimum density of 90% Modified Proctor, unless otherwise mentioned in schedule of quantities.

Prior to construction of form work for any item where soil will not act as bottom form, approval shall be obtained from Engineer-in-Charge as to the suitability of the soil.

4.21. PREPARATION OF ROCK STRATA OF FOUNDATIONS :

To provide tight bond with rock foundations, the rock surface shall be prepared and the following general requirements shall be observed:

Concrete shall not be deposited on large sloping rock surface. Where required by Engineer-in-Charge or as indicated on the plans, the rock shall be cut to form rough steps or benches to provide roughness or a more suitable bearing surface.

Rock foundation stratum shall be prepared by picking, barring, wedging and similar methods which will leave the rock in an entirely sound and unshattered condition.

Shortly before concrete is placed, the rock surface shall be cleaned with high pressure water and air jet even though it may have been previously cleaned in that manner.

Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by the Engineer-in-Charge.

Before placing concrete on rock surfaces, all water shall be removed from depressions to permit through inspection and proper bonding of the concrete to the rock.

4.22. PREPARATION OF EARTH STRATA OF FOUNDATIONS :

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft, yielding soils

shall be removed and replaced with suitable earth and well compacted as directed by the Engineer-in-Charge. Where specified, lean concrete shall be provided in the earth stratum for eceiving concrete. The surface of absorptive soil against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn form the freshly placed concrete and later shall help to cure the concrete.

4.23. PREPARATION OF CONCRETE SURFACES :

Preparation of concrete surface upon which additional concrete is to be placed later, shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting the surface with picks and stiff brooms and by use of an approved combination of air and water jet as directed by Engineer-in-charge. Great care shall be taken in performing this work to avoid removal of too much mortar and the weakening of the surface by loosening of aggregate. When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt, unsound concrete, laitance and glazed mortar have been removed.

4.24. BONDING TREATMENT (MORTAR) :

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, it shall receive a bonding treatment, immediately before placement of the concrete.

The bonding medium shall be a coat of cement sand mortar. The mortar shall have the same cement-sand proportion as the concrete which shall be placed on it. The water cement ratio shall be determined by placing conditions and as approved by Engineer-in-Charge.

Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 10 mm. thick for rock surface and about 5 mm. thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to a satisfactory degree as determined by Engineer-in-Charge.

Mortar shall be placed at such a rate that it can be brushed over the surface just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar takes place. The amount of mortar that will be permitted to be placed at any one-time, or the area which is to cover, shall be in accordance with Engineer-in-Charge.

4.25. CLEANING AND BONDING OF FORMED CONSTRUCTION JOINTS :

Vertical construction joints shall be cleaned as specified above or by other methods approved by Engineer-in-Charge. In placing concrete against formed construction joints, the surfaces of the joints, where accessible, shall be coated thoroughly with the specified bed-joint bonding mortar immediately before they

are covered with concrete or by scrubbing with wire brooms, dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by carefully puddling and spading with aid of vibrators and suitable tools.

4.26. EXPANSION AND CONTRACTION :

Provision shall be made for expansion and contraction in concrete by use of special type joints located as shown in the drawings. Construction joint surfaces shall be treated as specified in the specifications, shown in the drawings or as directed by Engineer-in-Charge.

4.27. HOT WEATHER REQUIREMENTS :

All concrete work performed in hot weather shall be in accordance with I.S. 456, except as herein modified.

Admixtures may be used only when approved by Engineer-in-Charge.

Adequate provision shall be made to lower concrete temperatures by cool ingredients, eliminating excessive mixing, preventing exposure of mixers and conveyers to direct sunlight and the use of reflective paint, on mixers etc. The temperature of the freshly placed concrete shall not be permitted to exceed 300C.

Consideration shall be given to shading aggregate stock piles from direct rays of the sun and spraying stock piles with water, use of cold water available and burying, insulation, shading and/ or painting white the pipe lines and water storage tanks and conveyances.

In order to reduce loss of mixing water, the aggregates, wooden forms, subgrade, adjacent concrete and other moisture absorbing surfaces, shall be well wetted prior to concreting. Placement and finishing shall be done as quickly as possible.

Extra precautions shall be taken for the protection and curing of concrete. Consideration shall be given to continuous water curing and protection against high temperatures and drying hot wind for a period of at least 7 days immediately after concrete has set and after which normal curing procedures may be resumed.

4.28. PLACING CONCRETE UNDER WATER :

Under all ordinary conditions all foundations shall be completely dewatered and concrete placed in the dry. However, when concrete placement under water is necessary, all work shall conform to I.S.456 and procedure shall be as follows:

Method of Placement : Concrete shall be deposited under water by means of tremies or drop bottom buckets of approved type.

4.29. DIRECTION, INSPECTION AND APPROVAL :

All work requiring placement of concrete underwater shall be designed, directed and inspected with regard to the local circumstances and purposes. All under

water concrete shall be placed according to the plans or specifications and as directed and approved by Engineer-in-Charge.

4.30. PRECAST CONCRETE & 4.31 PRECAST REINFORCED CONCRETE

Precast concrete & precast reinforced concrete shall comply with I.S. 456, and with the following requirements:

General requirements : Precast reinforced concrete units such as columns, fencing posts, door and window frames, lintels, chajjas, copings, sills, shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms / moulds shall be of fiber glass or of steel sections for better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. Precast concrete shall be cast on suitable bed or platform with firm foundation and free from wind. The contractor may precast the units on a cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in the forms. Each unit shall be cast in one operation. Contractor shall be responsible for the accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.

Concrete used for precasting the units should be well proportioned, mixed, placed and thoroughly compacted by vibrations or tamping to give a dense concrete free from voids and honeycombing.

Precast articles shall have a dense surface finish showing no coarse aggregate and shall have no cracks or crevices likely to assist in disintegration of concrete or rusting of steel or other defects that would interfere with the proper placing of the units. All angles of the precast units with the exception of the angles resulting from the splayed or chamfered faces shall be true right angles. The arises shall be clean and sharp except those specified or shown to be rounded. The wearing surface shall be true to the lines. On being fractured, the interior of the units should present a clean homogenous appearance.

The longitudinal reinforcement shall have a minimum cover of 12 mm or twice the diameter of the main bar, whichever is more, unless otherwise directed in respect of all items except fencing posts or electric posts where the minimum cover shall be 25 mm.

CURING

After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting.

The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled. Side shutters shall not be struck in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches a strength of

at least twice the stress to which the concrete may be subjected at the time of lifting.

MARKING

Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

Precast units shall be stored, transported and placed in position in such a manner that they will not be overstressed or damaged. The lifting and removal of precast units shall be undertaken without causing shocks, vibration or under bending stresses to or in the units. Before lifting and removal takes place, contractor shall satisfy Engineer-in-Charge or his representative that the methods he proposes to adopt for these operations will not over-stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

4.32 PRECAST CEMENT CONCRETE JALI :

The Jali shall be of cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 6 mm nominal size) reinforced with 1 .6 mm thick mild steel wire, unless otherwise specified.

Fixing : The Jali shall be set in position true to plumb and level before the joints, sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement : 3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.

Measurement : The Jali shall be measured for its gross superficial area. The length and breadth shall be measured correct to a cm. The thickness shall not be less than that specified.

Rate : The rate shall be inclusive of materials and labour involved in all the operations described above except plastering of jambs, sill and soffits, which will be paid for under relevant items of plastering.

CURING :

All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each units shall be kept constantly watered or preferably by completely immersed in water if the size of unit so permits. Otherwise curing practices as given in clauses stated earlier shall be followed.

1. SLOTS, OPENINGS ETC. :

Slots, openings or holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by the Engineer-in-Charge. Any deviation from the approved drawings shall be made good by contractor at his own expenses without damaging any other work. Sleeves, bolts, inserts etc. shall also be provided in concrete work where so specified.

2. GROUTING :

2.1 Standard Grout : Grout shall be provided as specified in the drawing.

The proportions of grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. The grout proportions shall be limited as follows:

Use	Grout thickness	Mix. proportions	W/C. Ratio in
a)Fluid	Under 25 mm.	One part Portland cement	0.44
b) General	25 mm. and over but less than 50 mm.	One part Portland cement to 2 parts of sand.	0.53
c) Stiff mix.	50 mm. and over	One part Portland cement to	0.53

Sand shall be such as to produce a flowable grout without any tendency to segregate. Sand, for general grouting purposes, shall be graded within the following limits:

Passing I.S. sieve 2.36 mm.	95 to 100%
Passing I.S. sieve 1.18 mm.	65 to 95%
Passing I.S. sieve 300 micron above	10 to 30%
Passing I.S. sieve 150 micron above	3 to 10%

Sand for fluid grouts shall have the fine material passing the 300 and 150 micron sieves at the upper limits specified above.

Sand for stiff grouts, shall meet the usual grading specifications and concrete.

Surface to be grouted shall be thoroughly roughened and cleaned of all foreign matter and laitance.

Anchor bolts, anchor bolt holes and bottom of equipment and column base plates shall be cleaned of all oil, grease, dirt and loose material. The use of hot, strong, caustic solution for this purpose will be permitted.

Prior to grouting, the hardened concrete surfaces to be grouted, shall be saturated with water. Water in anchor bolt holes shall be removed before grouting is started.

Forms around base plates shall be, reasonably, tightened to prevent leakage of the grout.

Adequate clearance shall be provided between forms and base plate to permit grout to be worked properly into place.

Grouting, once started shall be done quickly and continuously to prevent segregation, bleeding and breakdown of initial set. Grout shall be worked from

one side of one end to the other to prevent entrapment of air. To distribute the grout and to ensure more release from entrapped air, link chains can be used to work the grout into place.

Grouting through holes in base plate shall be by pressure grouting.

Variations in grout mixes and procedures shall be permitted if approved by the Engineer-in-Charge.

2.2 Special Grout : Special grout where specified on the drawing shall be provided in strict accordance with the manufacturers instructions/ specifications on the drawings.

3. INSPECTION :

All materials, workmanship and finished construction shall be subject to the continuous inspection and approval of Engineer-in-Charge.

All rejected materials supplied by contractor and all rejected work or construction performed by contractor, as is not in conformance with the specifications and drawings, shall immediately be replaced at no additional expense.

Approval of any preliminary material or phase of work shall in no way relieve the contractor from the responsibility of supplying concrete and/ or producing finished concrete in accordance with the specifications and drawings.

All concrete shall be protected against damage until final acceptance by the E.I.C.

4. CLEAN UP :

Upon the completion of concrete work, all forms, equipments, construction tools, protective coverings and any debris resulting from the work shall be removed from the premises.

All debris i.e. empty containers, scrap wood etc. shall be removed to dump daily or as directed by the Engineer-in-Charge.

The finished concrete surfaces shall be left in a clean condition to the satisfaction of the Engineer-in-Charge.

5. PLAIN CEMENT CONCRETE FOR GENERAL WORK :

For plain cement concrete work, the specification for materials viz. cement, sand, fine and coarse aggregates and water shall be the same as that specified in reinforced concrete work specification.

But the proportion of mix will be nominal and the ratio of fine and coarse aggregate may be slightly adjusted within limits, keeping the total value of aggregates to a given volumes of cement constant to suit the sieve analysis of both the aggregates. Cement shall on no account be measured by volume, but it shall always be used directly from the bags (i.e. 50 kg/bag).

The proportion of cement, sand, aggregate and water for concrete of proportion 1:5:10, 1:4:8, 1:3:6 & 1:2:4 by volume shall generally consist of quantities as given below :

Proportion of	**Cement**	**Quantity of materials used per bag of**			
		Fine aggregate	**Coarse aggregate**	**Total of fine sand**	**Water**
1:5:10	1	175 ltrs.	350	800	60 ltrs.
1:4:8	1	140 ltrs.	280	625	45 ltrs.
1:3:6	1	105 ltrs.	210	480	34 ltrs.
1:2:4	1	70 ltrs.	140	330	32 ltrs.

The quantity of water used shall be such as to produce concrete of consistency required by the particular class of work and shall be decided by the use of a slump cone. Sufficient care should be taken to see that no excess quantity of water is used. The final proportion of the aggregate and quantity of water shall be decided by the Engineer-in-charge on the basis of test in each case.

Mix proportion	**Cement**	**Sand**	**Coarse Aggregate in CUM**			**Water**
Ordinary mix in volume	**in bags**	**in cum**	**40 mm**	**20 mm**	**12 mm**	
1:5:10	2.60	0.475	0.6623	0.2583	-	156
1:4:8	3.40	0.500	0.688	0.6883	-	153
1:3:6 (with 40mm	4.4	0.485	0.672	0.672	0.262	176
1:3:6 (with 20 mm	4.4	0.485	-	0.727	0.242	162.5
1:2:4 (with 20 mm	6.4	0.47	-	0.705	0.235	205
1:2:4 (with 40 mm	6.4	0.47	0.544	0.241	0.126	235
1:1.5:3	8.0	0.441	-	0.6615	0.2205	240
1:1:2	12.2	0.45	-	0.675	0.225	330

The slump shall be specified for each class of work and shall in general be as follows:

Type of concrete	**Max. slump (in**
Mass concrete	50
Concrete below water proofing treatment	50
Coping	25
Floor paving	50

All plain concrete should be preferably mixed in a drum type powder driven machine with a loading hopper which will permit the accurate measure of various ingredients. If hand mixing is authorised, it should be done on a water tight platform.

The mixing of each batch in the concrete mixer shall continue for not less than 1.5 minutes after the materials and water are in the mixer. The volume is mixed materials per batch shall not exceed the manufacturers rated capacity of the mixer. The mixer shall rotate at a peripheral speed of about 60 metres per minute.

Concrete shall be poured and consolidated in its final position within half an hour of mixing. The retempering of concrete which has partially hardened, that is remixing with or without additional cement aggregate or water shall not be permitted. Concrete of mix 1:3:6 and 1:2:4 will be required to be vibrated if specified and directed by the Engineer. In case of the thickness of concrete is more than 150 mm., it may be vibrated as directed by the Engineer.

The concrete shall be cured for 10 days in ordinary weather and 15 days in hot weather.

Measurements for the work done shall be exact length, breadth and depth shown in figures on the drawings or as directed by the Engineer and after the concrete is consolidated. No extra shall be paid for excess quantity resulting from faulty workmanship.

6. SPECIFIC REQUIREMENTS FOR CONCRETE AND ALLIED WORKS :

The following specific requirements shall be met within addition to those provided in the clause of specification for Concrete and allied works.

General : The contractor shall be solely responsible for supplying mixed concrete in accordance with the specification for concrete and allied works and also this specification.

Water : Clean water in pipes under pressure shall be provided by the contractor with all necessary equipment for giving a nozzle pressure of not less than 2.0 kg/ sqcm. for the convenient and effective jetting of rock foundations and concrete surfaces, for cooling aggregate required for concrete, for curing concrete and other requirements.

Fire Protection System : The contractor shall provide and maintain at all times in adequate fire protection system to protect his equipment, materials and construction In case of an emergency, the contractor shall permit the Engineer-in-Charge to use the system for protecting equipment, works etc. on the project.

Concrete : The rates for all concrete work should be based as per specifications and taking into consideration the guidelines indicated in special instruction under relevant clause.

The Placement Intervals : Each placement of concrete shall be allowed to set for a period of 48 hours and longer when required, before the start of subsequent placement. A time gap between the two adjoining pours in the horizontal plane and the two adjacent pours in the vertical plane shall be 7 days and 3 days respectively.

FINISHING OF CONCRETE :

1. General : Unless otherwise specified, concrete finishes shall conform to the

following specifications: Finish F1, F2 and F3 shall describe formed surface.

Finish U1, U2 and U3 shall describe un-formed surface.

Off sets or fins caused by disposed or misplaced form sheathing lining or form sections or by defective form lumber shall be referred to as abrupt irregularities. All other irregularities shall be referred to as gradual irregularities. Gradual irregularities shall be measured as deviation from a plane surface with a template 1.5 m. long for formed surface and 3 m. long for unformed surfaces.

2. Formed Surfaces :

Finish F1—shall apply to all formed surfaces for which finish F2, F3 or any other special finish is not specified and shall include filling up all form tie holes.

Finish F2—shall apply to all formed surfaces so shown on the drawings or specified by the Engineer-in-Charge. This shall include filling all form tie-holes, repair of gradual irregularities exceeding 6 mm., removal of ridges and abrupt irregularities by grinding.

Finish F3—shall apply to all formed surfaces exposed to view or where shown in the drawings or specified by the Engineer-in-Charge. Finish F3 - shall include all measures specified for Finish-F2 and in addition, Filling air holes with mortar and treatment of the entire surface with sack rubbed finish. It shall also include clean up of loose and adhering debris. Where a sack rubbed finish is specified, the surfaces shall be prepared within two days after removal of the forms.

The surface shall be wetted and allowed to dry slightly before mortar is applied by sack rubbing. The mortar used shall consist of one part cement to one and half parts by volume of fine (minus No. 16 mesh) sand. Only sufficient mixing water to give the mortar a workable consistency shall be used. The mortar shall then be rubbed over the surface with a fine burlap or linen cloth so as to fill all the surface voids. The mortar rubbed in the voids shall be allowed to stiffen and solidify after which the whole surface shall be wiped clean so that the surface presents a uniform appearance without air holes, irregularities etc.

Curing of the surface shall be continued for a period of ten (10) days.

3. Unformed Surfaces :

Finish U1—shall apply to all unformed surfaces for which the finish U2, U3 or any other special finish is not specified and shall include screeding the surface of the concrete to the required slope and grade. Unless the drawing specifies a horizontal surface or shows the slope required, the tops of narrow surfaces such as stair, treads, walls, curbs and parapets shall be sloped approximately 10 mm. per 300 mm. width. Surfaces to be covered by backfill or concrete sub-floors to be covered with concrete topping, terrazzo and similar surfaces shall be smooth screeded and leveled to produce even surface, irregularities not exceeding 6 mm.

Finish U2—shall apply to all unformed surfaces as shown in the drawing or specified by the Engineer-in-Charge and shall include screeding and applying a wood float finish to the surface of the concrete to the required slopes and grade.

Repair of abrupt irregularities unless a roughened texture is specified. Repair of gradual irregularities exceeding 6 mm.

Finish U3—shall apply to unformed surfaces for which a high degree of surface smoothness is required, where shown on the drawing or specified by the Engineer-in-Charge. This shall include screeding, floating and applying a steel trowel finish to the surface of the concrete to the required slopes and grade.

Repair of abrupt irregularities.

Repair of gradual irregularities exceeding 6 mm., finishing joints and edges of concrete with edging tools.

MODE OF MEASUREMENT FOR CONCRETE WORK :

General : Concrete as actually done shall be measured for payment, subject to the following tolerances, unless otherwise stated hereinafter. Any work done extra over the specified dimensions shall not be measured for payment.

a) Linear dimensions shall be measured in full centimetres except for the thickness of slab which shall be measured to the nearest half centimetre.

b) Areas shall be worked out to the nearest 0.01 sqm.

c) Cubic contents shall be worked out to the nearest 0.001 cum.

d) The concrete shall be measured for its length, breadth and height/ depth limiting dimensions to those specified on drawings or as directed by the Engineer-in-Charge.

NOTE : The sizes of RCC members as assumed in the estimate are based on preliminary drawings and are likely to be changed. The contractor is not entitled to any extra claim due to such changes.

Deductions:

No deductions shall be made for the following :

a) Ends of dissimilar materials e.g. joists, beams, posts, girders, rafters, purlins, trusses, corbels, steps etc. upto 500 sq cm. in cross section.

b) Opening upto 0.1 sqm. (1000 sq cm)

c) Volume occupied by reinforcement.

d) Volume occupied by pipes, conduits, sheathing etc. not exceeding 25 sq cm. each in cross sectional area. Nothing extra shall be paid for leaving and finishing such cavities and holes.

i. COLUMN FOOTING :

R.C.C. in foundation and footings shall be measured for its length, breadth and depths limiting dimensions to those specified in drawing or as ordered in writing by the Engineer-in-Charge. In case of tapering portions of column footings, the quantities shall be calculated by the Formula : **Volume V = H/3 x [A1 + A2 + sqrt {A1 x A2}] ;** where A1 = Area at top of footing, A2 = Area at bottom of footing and H = Height of footing.

ii. COLUMN :

Column shall be measured from top of footings to the plinth level and from plinth level to the structural slab level and to the subsequent structural slab levels. Measurements for higher grade concrete in columns at its junction with lower grade concrete beams shall be restricted to the column section supporting the beam in question.

iii. WALL

All walls shall be measured from top of the wall footing to the plinth level and from plinth level to the top of structural first floor and to subsequent floors.

iv. BEAM AND LINTEL :

Beam shall be measured from face to face of the columns, walls, cross beams including haunches if any. The depth of the beams shall be measured from the top of the slab to the bottom of the beam except in the case of inverted beam where it shall be measured from top of slab to top of beams. The beams and lintels with narrow width even though acting as facia in elevation in some cases, will be measured as beams and lintels only.

v. SLAB :

The length and breadth of slab laid to correct thickness as shown in the detailed drawings or as ordered by the Engineer-in-Charge shall be measured between beams, walls and columns.

vi. CHAJJAS, FACIAS, FINS AND MULLIONS:

a) Chajjas shall be measured net from supporting faces upto the edges of chajjas without any facia.

b) Facia shall be measured full excluding chajja thickness.

c) End fins shall be measured full.

d) Intermediate fins, mullions shall be measured between chajjas or other supporting structural members.

e) Parapets shall be measured from top of slab/ chajja.

vii. STAIRCASE :

The concrete in all members of staircase like waist slabs, steps, cantilever steps, stringer beams etc. shall be measured for their length, breadth and depth, limiting dimensions to those specified on drawings. No deductions shall be made for embedded plugs, pockets.

Rates: The rate for P.C.C/ R.C.C. shall include the cost of all materials, labour, transport, tools and plants and all the operations mentioned hitherto, including or excluding the cost of form work and/ or reinforcement as mentioned in the schedule of quantities. The rates also shall include the cost of testing materials, mix design, cube test and allied incidental expenses.

* * *

5. FORM WORK :

5.0. GENERAL :

The form work shall consist of **Film faced shuttering plywood** ,shores, bracings, sides of beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts etc. complete which shall be properly designed and planned for the work. The false work shall be so constructed that up and down vertical adjustment can be made smoothly. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment or dismantling of form work. The forwork shall be clean,smooth & straight .

5.1. DESIGN OF FORM WORK :

The design and engineering of form work as well as its construction shall be the responsibility of Contractor. If so instructed, the drawings and calculations for the design of the form work shall be submitted well in advance to the Engineer-in-Charge for approval before proceeding with work, at no extra cost . Engineer-in-Charges approval shall not however, relieve Contractor of the full responsibility for the design and construction of the form work. The design shall take into account all the loads vertical as well as lateral that the forms will be carrying including live and vibration leadings.

5.2. TOLERANCES :

Tolerances are a specified permissible variation from lines, grade or dimensions given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be constructed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted:

5.2.1. TOLERANCES FOR R.C. BUILDINGS :

i. Variation from the plumb:

a. In the line and surfaces of columns, piers, walls and in buttresses: 5 mm. per 2.5 m., but not more than 25 mm

b. For exposed corner columns and other conspicuous lines.
In any bay or 5 m. maximum: (+/-) 5 mm.

In 10 m. or more: (+/-) 10 mm.

ii. Variation from the level or from the grades indicated on the drawings.

a. In slab soffits, ceilings, beam soffits and in arrises.
In 2.5 m.: (+/-) 5 mm.

In any bay or 5 m. maximum: (+/-) 8 mm.

In 10 m. or more: (+/-) 15 mm.

b. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.
In any bay or 5 m. maximum: (+/-) 15 mm.

In 10 m or more: (+/-) 10 mm.

iii. Variation of the linear building lines from established position in plan and related position of columns, walls and partitions.

In any bay or 5 m. maximum: (+/-) 10 mm.

In 10 m or more: (+/-) 20 mm.

iv. Variations in the sizes and locations of sleeves, openings in walls and floors except in the case of and for anchor bolts: (+/-) 5 mm.

v. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls: (+) 10 mm./(-) 5 mm.

vi. **Footings:**

a) Variation in dimensions in plan: (+) 50 mm./(-) 5 mm.

b) Misplacement or eccentricity: 2% of footing within the direction of misplacement but not more than 50 mm.

c) Reduction in thickness: (-) 5% of specified thickness subject to maximum of 50 mm.

vii. **Variation in steps.**

a) In a flight of stairs.
Rise:

Tread:

b) In consecutive steps. (+/-) 3.0 mm. (+/-) 5.0 mm.
Rise: (+/-) 1.5 mm.

Tread: (+/-) 3 mm.

5.2.2. TOLERANCES IN OTHER CONCRETE STRUCTURE :

A) All structures:

i) Variation of the constructed linear outline from established position in plan.
In 5 m.: (+/-) 10 mm.

In 10 m. or more: (+/-) 15 mm.

ii) Variation of dimensions to individual structure features from established positions in plan.
In 20 m. or more: (+/-) 25 mm.

In buried constructions: (+/-)150 mm.

iii) Variation from plumb, from specified batter or from curved surfaces of all structures.
In 2.5 m.: (+/-) 10 mm.

In 5.0 m.: (+/-) 15 mm.

In 10.0 m. or more: (+/-) 25 mm.

In buried constructions: (+/-) Twice the above limits

iv) Variation from level or grade indicated on drawings in slabs, beams, soffits, horizontal grooves and visible arises.

In 2.5 m.: (+/-) 5 mm.

In 7.5 m. or more: (+/-) 10 mm.

In buried constructions: (+/-) Twice the above limits.

v) Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members. (+)12 mm./(-) 6 mm.

vi) Variation in the thickness of slabs, walls, arch sections and similar members. : (+)12 mm./(-) 6 mm.

B) Footings for columns, piers, walls, buttresses and similar members:

i) Variation of dimensions in plan: (+)50 mm./(-)12 mm.

ii) Misplacement or eccentricity: 2% of footing within the direction of misplacement but not more than 50 mm.

iii) Reduction in thickness: 5% of specified thickness subject to a maximum of 50 mm.

Tolerances in other types of structures shall generally conform to those given in Clause 2.4 of Recommended Practice for concrete form work (ACI 347)

5.3. TYPE OF FORMWORK :

Form work may be of timber, **Film faced plywood**, metal, plastic or concrete. For special finishes, the formwork may be lined with plywood, steel sheets, oil tempered hard board etc. Sliding forms and slip forms may be used with the approval of Engineer-in- Charge.

5.4. FORMWORK REQUIREMENTS :

Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for in the drawings. Ample studs, waler braces, straps, shores etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases, from vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free form sap, shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water and fine material from concrete.

Plywood shall be used for exposed concrete surfaces, where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planed to remove irregularities or unevenness in the face. Form work with lining will be permitted.

All new and used from lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Engineer-in-Charge shall be removed from the site.

Shores supporting successive stories shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundation.

Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be entirely removed and the formwork corrected prior to placing new concrete.

Excessive construction camber to compensate for shrinkage settlement etc. that may impair the structural strength of members will not be permitted.

Forms for substructure concrete may be omitted when, in the opinion of Engineer-in-Charge, the open excavation is firm enough to act as the form. Such excavations shall be slightly larger than required by the drawings to compensate for irregularities in excavation and to ensure the design requirement.

Forms shall be so designed and constructed that they can be stripped in the order required and their removal do not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conforming to the architectural features of the structure as to location of joints and be as directed by Engineer-in-Charge.

Where exposed smooth or rubbed concrete finishes are required, the forms shall be constructed with special care so that the desired concrete surfaces could be obtained which require a minimum finish.

BRACINGS, STRUTS AND PROPS :

Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bracings.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of beams and under the soffit of slab can be removed without disturbing the beam bottoms.

Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.

If the shuttering for a column is erected for the full height of the column, one side shall be left open and built upon sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 m. or as directed by Engineer-in-Charge.

5.5. INSPECTION OF FORM WORK :

Following points shall be borne in mind while checking during erection of form work and form work got approved by the Engineer-in-charge before placing of reinforcement bars :

a. Any member which is to remain in position after the general dismantling is done, should be clearly marked.

b. Material used should be checked to ensure that, wrong items / rejects are not used.

c. If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.

d.

i. The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground.

ii. Sole plates shall be properly seated on their bearing pads or sleepers.

iii. The bearing plates of steel props shall not be distorted.

iv. The steel parts on the bearing members shall have adequate bearing areas.

e. Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.

f. Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.

g. The stacked materials shall be placed as catered for, in the design.

h. When adjustable steel props are used, they should :

   i) be undamaged and not visibly bent.

   ii) have the steel pins provided by the manufacturers for use.

   iii) be restrained laterally near each end.

   iv) have means for centralising beams placed in the forkheads.

i. Screw adjustment of adjustable props shall not be over extended.

j. Double wedges shall be provided for adjustment of the form to the required position wherever any settlement / elastic shortening of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightended / clamped down after adjustment to prevent their shifting.

k. No member shall be eccentric upon vertical member.

l. The number of nuts and bolts shall be adequate.

m. All provisions of the design and / or drawings shall be complied with.

n. Cantilever supports shall be adequate.

o. Props shall be directly under one another in multistage constructions as far as possible.

p. Guy ropes or stays shall be tensioned properly.

q. There shall be adequate provision for the movement and operation of vibrators and other construction plant and equipment.

r. Required camber shall be provided over long spans.

s. Supports shall be adequate, and in plumb within the specified tolerances.

5.6. FORM OIL :

Use of form oil shall not be permitted on the surface which require painting. If the contractor desire to use form oil on the inside of formwork of the other concrete structures, a non staining mineral oil or Mould Releasing agent of Sika/Fosroc or approved equivalent make or other approved oil CEMOL-35 of Ms. Hindustan Petroleum Co. Ltd. may be used, provided it is applied before placing reinforcing steel and embedded parts. All excess oil on the form surfaces and any oil on metal or other parts to be embedded in the concrete shall be carefully removed. Before treatment with oil, forms shall be thoroughly cleared of dried splatter of concrete from placement of previous lift.

5.7. CHAMFERS AND FILLERS :

All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillers on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 20 x 20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

5.8. VERTICAL CONSTRUCTION JOINT CHAMFERS :

Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not permitted by Engineer-in-Charge for structural or hydraulic reasons.

5.9. WALL TIES :

Wire ties passing through the walls, shall not be allowed. Also through bolts shall not be permitted. For fixing of formwork, alternate arrangements such as coil nuts shall be adopted at the contractors cost.

5.10. REUSE OF FORMS :

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer-in-charge. Warped lumber shall be resized. Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

5.11. REMOVAL OF FORMS :

Contractors shall record on the drawings or a special register, the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

In no circumstances shall forms be struck until the concrete reaches a strength of the at least twice the stress due to self weight and any construction erection loading to which the concrete may be subjected at the time of striking formwork.

In normal circumstances (generally where temperatures are above 15 ^{0}C.) forms may be struck after expiry of the following periods :

Stripping time:

Sl.No.	Type of form work	Minimum period before
a)	Vertical form work to columns, walls beams	16 – 24 h
b)	Soffit form work to slabs (Props to be refixed immediately after	3 days
c)	Soffit form work to beams (Props to be refixed immediately after	7 days
d)	Props to slabs: 1) Spanning up to 4.5 m	7 days 14 days
e)	Props to beams and arches; 1) spanning up to 6 m	14 days 21 days

For other cements and lower temperature, the stripping time recommended above may be suitably modified.

The number of props left under the sizes and the position shall be such as to able to safey carry the full dead load of the slab, beam or arch., as the case may be together with any live load likely to occur during curing or further constructions.

Where the shape of the element is such that the form work has the reentrant angles the form work shall be removed as soon as possible. After the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.

Striking shall be done slowly with utmost care to avoid damage to arise and projection and without shock or vibration, by gently easing the wedges. If after removing the formwork, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provided, as directed by Engineer-in-Charge, to facilitate removal of formwork which otherwise may be in-accessible.

Tie rods, clamps, form bolts etc. which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hours after concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties withdrawn from walls and grade beams shall be pulled towards the inside face. Cutting ties back from the faces of walls and grade beams will not be permitted. Work damaged due to premature or careless removal of forms shall be re-constructed at contractors cost.

5.12. MODE OF MEASUREMENT :

In case the items of concreting are inclusive of cost of form work, no separate measurements shall be taken for form work. However, if the form work is to be paid separately and the item exists in the Schedule of Quantities for various types of form work, the net area of exposed surface of concrete members as shown in drawings coming in contact with form work shall be measured under item of formwork in square meters.

All temporary formwork such as bulk heads, stop boards provided at construction joints which are not shown in the drawings shall not be measured.

No deductions shall be made for openings/ obstructions upto an area of 0.1 sqm. and nothing extra shall be paid for forming such openings.

The rate shall include the cost of erecting, centering, shuttering materials, transport, deshuttering and removal of materials from site and labour required for all such operations etc.

6 . STEEL FOR CONCRETE REINFORCEMENT :

Please refer special ''APPENDIX-F'' for steel reinforcement

6.1. SCOPE OF MATERIAL:

The contractor shall make his own arrangement for procurement of Reinforcement steel bars and wires for use in Reinforced Cement Concrete works. Unless otherwise specified in drawings / Schedule of quantities, the steel bars shall be of "High strength deformed steel bars and wires" conforming to the IS 1786 (latest revision), in the following strength grades:

a) Fe 415, Fe 415D;

b) Fe 500, Fe 500D;

c) Fe 550, Fe 550D; and

d) Fe 600.

Where **"Fe"** stands for specified minimum 0.2% proof / yield stress in N/mm^2 and **"D"** stands for same specified minimum 0.2% proof / yield stress but with enhanced specified minimum percentage elongation.

6.2. TERMINOLOGY:

Elongation: The increase in length of a tensile test piece under stress, expressed as a percentage of the original gauge of a standard piece.

Longitudinal Rib -A uniform continuous protrusion, parallel to the axis of the bar/wire (before cold-working, if any).

Nominal Diameter or Size- The diameter of a plain round bar/wire having the same mass per metre length as the deformed bar/wire.

Nominal Mass -The mass of the bar/wire of nominal diameter and of density 0.00785 kg/cumm per meter.

Nominal Perimeter - 3.14 times the nominal diameter of a deformed bar/Wire.

Percent Proof Stress -The stress at which a non-proportional elongation equal to 0.2% of the original gauge length takes place.

Uniform elongation - The elongation corresponding to the maximum load reached in a tensile test (also termed as percentage total elongation at maximum force).

Tensile Strength - The maximum load reached in a tensile test divided by the effective cross-sectional area of the gauge length portion of the test piece (also termed as ultirnate tensile stress).

Transverse Rib - Any rib on the surface of a bar/wire other than a longitudinal rib.

Yield Stress - Stress (that is, load per unit cross sectional area) at which elongation first occurs in the test piece without increasing the load during the tensile test. In the case of steels with no such definite yield point, proof stress shall be applicable.

The high strength deformed steel bars and wires for concrete reinforcement shall be hot rolled steel without subsequent treatment or hot rolled steel with controlled cooling and tempering and cold worked steel, and reinforcing bars and wires which may be subsequently coated.

6.3. TESTS:

The contractor shall submit the test certificate of manufacturer. Regular tests on steel supplied by the contractor shall be performed by the contractor at the approved lab, in presence of the MDL Engineers as per relevant Indian Standards. Engineer-in-charge may require Contractor to perform necessary tests of samples at random as per relevant B.I.S. All cost of such tests and incidentals to such

tests shall be borne by the Contractor. The quality, grade, colour coding embossing marks etc. all shall be to the entire satisfaction of the Engineer-in-Charge. Steel not conforming to above test criteria shall be rejected.

The Chemical, Physical & Mechanical properties of the steel reinforcement bars shall be as per IS 1786. Unless otherwise specified, Selection and Preparation of Test Sample shall be as per the requirements of IS 2062.

All test pieces shall be selected either from the cuttings of bars / wires; or from any bar/wire after it has been cut to the required or specified size and the test piece taken from any part of it. In neither case, the test piece shall be detached from the bar/wire except in the presence of the EIC or his authorized representative.

The test pieces shall be full sections of the bars/wires and shall be subjected to physical tests without any further modifications. No reduction in size by machining or otherwise shall be permissible, except in case of bars of size 28 mm and above. No test piece shall be annealed or otherwise subjected to heat treatment. Any straightening which a test piece may require shall be done cold.

For the purpose of carrying out tests for tensile strength, proof stress, percentage elongation and percentage elongation at maximum force for bars 28 mm in diameter and above, deformations of the bars only may be machined. For such bars, the physical properties shall be calculated using the actual area obtained after machining. The following IS codes shall be referred for test methods:

SN	Title	IS No	ISO No.
i	Mechanical testing of metals -Tensile	1608	6892
ii	Methods for bend test	1599 7438 &	15630-1
iii	Method for re-bend test for metallic wires &	1786	15630-1

THE PROPERTIES AS PER IS 1786 – 2008 ARE REPRODUCED BELOW:

Chemical Composition of the bars produce shall conform to the following requirement:

Constituents			Maximum Permissible Percent					Permissible
	Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600	max.
Carbon	0.300	0.250	0.300	0.250	0.300	0.250	0.300	0.020%
Sulphur	0.060	0.045	0.055	0.040	0.055	0.040	0.040	0.005%
Phosphoru	0.060	0.045	0.055	0.040	0.050	0.040	0.040	0.005%
Sulphur &	0.110	0.085	0.105	0.075	0.100	0.075	0.075	0.010%

Notes:

1. For guaranteed weldability, the carbon equivalent, CE using the formula:

   CE = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15

Shall not be more than 0.53 percent, when micro-alloy/low alloys are used. When micro-alloy/low alloys are not used, carbon equivalent using the formula:

2. CE = C + Mn/6

Shall not be more than 0.42 percent. Reinforcement bars/wires carbon equivalent above 0.42 percent should, however be welded with precaution. Use of low hydrogen basic coated electrodes with matching strengths bars/wires is recommended.

Contractor shall satisfied above notes 1&2.

Mechanical Properties of High Strength Deformed Bars and Wires

Sl. No.	**Property**			**Maximum Permissible**				
		Fe 415	**Fe 415D**	**Fe 500**	**Fe 500D**	**Fe 550**	**Fe 550D**	**Fe 600**
1	2	3	4	5	6	7	8	9
i	0.2 percent proof stress / yield stress,	415.0	415.0		500.0	550.0	550.0	600.0
ii	Elongation, percent, Min. on gauge length 5.65 ;A, where A is	14.5	18.0	12.0	16.0	10.0	14.5	10.0

iii	Tensile strength, Min	10% more than the actual 0.2% proof stress/yield stress but not less than 485.0 N/mm²	12% more than the actual 0.2% proof stress/yield stress but not less than 500.0 N/mm²	8% more than the actual 0.2% proof stress/yiel d stress but not less than 545.0 N/mm²	10% more than the actual 0.2% proof stress/yield stress but not less than 565.0 N/mm²	6% more than the actual 0.2% proof stress/ yiel d stress but not less than 585.0 N/mm²	8% more than the actual 0.2% proof stress/yield stress but not less than 600.0 N/mm²	6% more than the actual 0.2% proof stress/ yiel d stress but not less than 660.0 N/mm²
iv	Total elongation at maximum force, percent, Min of gauge length 5.65 ;A, where A is the cross sectional area of the test piece	-	5	-	5	-	5	-

Note: To satisfy Clause 26 of IS 456 -2000, no mixing of different types of grades of bars shall be allowed in the same structural members as main reinforcement, without prior written approval of the Engineer-in-Charge.

6.4. QUALITY :

Steel not conforming to specifications shall be rejected. All reinforcement shall be clean, free from grease, oil, paint, dirt, loose mill, scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. All bars shall be rigidly held in position before

concreting. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer-in-Charge. If welding is approved, the work shall be carried as per I.S. 2751, according to best modern practices and as directed by the Engineer-in-Charge. In all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars welded. Substitution of reinforcement will not be permitted except upon written approval from Engineer-in-charge.

6.5. STACKING & STORAGE :

Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion. The steel for reinforcement shall not be kept in direct contact with ground. Fresh / Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deteriorations. Care shall be taken to protect steel from exposure to saline atmosphere during storage, fabrication and use. It may be achieved by treating the surface of reinforcement with cement wash or by suitable methods. Bars of different classifications, sizes and lengths shall be stored separately to facilitate issue in such sizes and lengths to cause minimum wastage in cutting from standard length.

6.6. NOMINAL SIZES

The nominal sizes of bars/wires shall be 4mrn, 5mrn, 6mrn, 8mrn, 10mrn, 12mrn, 16mrn, 20mrn, 25 mm, 28mrn, 32mrn, 36mrn, 40 mm. (Other sizes viz. 7mrn, 18mrn, 22 mm, 45 mm and 50 mm may be procured on specific stipulations).

6.7. NOMINAL MASS

For the purpose of checking the nominal mass, the density of steel shall be taken as 0.00785 kg/mm^3 of the cross-sectional area per metre. Unless otherwise specified, the tolerances on nominal mass shall be as per following Table.

Tolerances on Nominal Mass

SN	Nominal Size in mm	Tolerance on the nominal mass in		
		Batch	Individual sample	Individual sample for coils
1	2	3	4	5
i)	Up to and including 10	± 7	- 8	± 8
ii)	Over 10 up to and	± 5	- 6	± 6
iii)	Over 16	± 3	- 4	± 4

6.8. LAPS :

Laps and splices for reinforcement shall be shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the drawings, shall be approved by the Engineer-in-Charge. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

6.9. BENDING :

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawing / bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the materials. Bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 25 mm. in diameter which may be bent hot if specifically approved by the Engineer-in-Charge. Bars that depend for their strength on cold working shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 645^0C) and after bending shall be allowed to cool slowly with out quenching. Bars incorrectly bent shall be used only after straightening and re-bending be such as shall not, in the opinion of the Engineer-in-Charge, injure the material. No reinforcement bar shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

BENDING AT CONSTRUCTION JOINTS :

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameters for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

6.10. FIXING / PLACING AND TOLERANCE ON PLACING :

Reinforcement shall be accurately fixed by any approved means maintained in the correct position as shown in the drawings by the use of blocks, spacers and chairs as per I.S. 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing point shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bars in beams or similar members shall be maintained by the provision of spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

TOLERANCE ON PLACING OF REINFORCEMENT :

Unless otherwise specified, reinforcement shall be placed within the following tolerances :

Tolerance in spacing

a) For effective depth, 200 mm or less + /- 10 mm

b) For effective depth, more than 200 mm + /- 10 mm

6.11. COVER TO REINFORCEMENT :

Nominal cover is the design depth of concrete cover to all steel reinforcements, including links. It is the dimension used in design and indicated in the drawings. It shall be not less than the diameter of the bar. Unless otherwise specified, cover to reinforcement shall be provided generally as per guidelines of IS 456.

Nominal cover to meet durability requirement:

Minimum values for the nominal cover of normal weight aggregate concrete which should be provided to all reinforcement, including links depending on the condition of exposure described in 4.4 above and as per (nominal cover to meet durability requirements).

However for a longitudinal reinforcing bar in a column nominal cover shall in any case not be less than 40 mm or less than the diameter of such bar. In the case of columns of minimum dimension of 200 mm or under, whose reinforcing bar do not exceed 12 mm , a nominal cover of 25 mm may be used.

For footings minimum cover shall be 50 mm.

Nominal cover to meet specified period of fire resistance

Minimum values of nominal cover of normal-weight aggregate concrete to be provided to all reinforcement including links to meet specified period of the resistance as per the tables given under clause of this specifications.

The cover shall in no case be reduced by more than one third of specified cover or 5 mm whichever is less.

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish shall be as follows:

a) At each end of reinforcing bar not less than 25mm., nor less than twice the diameter of such, bar.

b) For a longitudinal reinforcing bar not less than 25 mm., nor more than 40 mm., nor less than the diameter of such bar. In the case of column of maximum dimensions of 200 mm. or under, whose reinforcing bars do not exceed 12 mm., a cover of 25 mm. may be used.

c) For longitudinal reinforcing bar in a beam, not less than 25mm., nor less than diameter of such bar.

d) For tensile, compressive, shear, or other reinforcement in a slab, not less than 25 mm, nor less than the diameter of such bar, and

e) For any other reinforcement not less than 15 mm., nor less than the diameter of such bar.

f) Increased cover thickness may be provided when surfaces of concrete members are exposed to the action of harmful chemicals (as in the case of concrete in contact with earth faces contaminated with such chemicals), acid, vapour, saline atmosphere, sulphurous smoke (as in the case of steam-operated railways) etc. and such increase of cover may be between 15 mm. and 50 mm. beyond the figures given in (a to e) above as may be specified by the Engineer-in-Charge.

g) For reinforced concrete members, totally immersed in sea water, the cover shall be 40 mm. more than specified (a to e) above.

h) For reinforced concrete members, periodically immersed in sea water or subject to sea spray, the cover of concrete shall be 50 mm. more than that specified (a to e) above.

i) For concrete of grade M 25 and above, the additional thickness of cover specified in (f), (g) and (h) above may be reduced to half. In all such cases the cover should not exceed 75 mm.

j) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing dense impermeable concrete with approved protective coating, as specified on the drawings. In such case the extra cover, mentioned in (h) and (i) above, may be reduced by the Engineer-in-Charge, to those shown on the drawing.

k) The correct cover shall be maintained by cement mortar briquettes or other approved means. Reinforcement for footings, grade beams and slabs on subgrade shall be supported on precast concrete blocks as approved by the Engineer-in-Charge. The use of pebbles or stones shall not be permitted.

l) The minimum clear distance between reinforcing bars shall be in accordance with I.S. 456 or as shown in drawing.

6.12. THE BARS SHALL BE KEPT IN CORRECT POSITION BY THE FOLLOWING METHODS.

a) In case of beam and slab construction precast cover blocks in cement concrete of M50 or more Grade of concrete about 4 x 4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcement.

b) In case of cantilevered and doubly reinforced beams or slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 metre or at shorter spacing to avoid sagging.

c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them; or with block of M50 or more Grade of concrete of required size suitably tied to the

reinforcement to ensure that they are in correct position during concreting.

d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates shall be used as directed by Engineer-in-Charge.

6.13. INSPECTION :

Erected and secured reinforcement shall be inspected and approved by Engineer-in-Charge prior to placement of concrete.

6.14. MODE OF MEASUREMENT FOR REINFORCEMENT FOR R.C.C. WORKS :

Reinforcement as detailed in schedule of quantities shall be measured for payment lineally as per the cutting length nearest to a centimetre shown in bar bending schedule submitted by the contractor and approved by the Engineer-in-Charge and weight calculated based on the standard weights as per I.S.1786, as indicated in the following table:

Nominal size in	**6**	**7**	**8**	**10**	**12**	**16**	**18**	**20**
Cross Sectional area	28.30	38.50	50.30	78.60	113.1	201.2	254.	314.30
Mass / Weight in Kg	0.222	0.302	0.395	0.617	0.888	1.580	2 .000	2 .47
Nominal size in	**22**	**25**	**28**	**32**	**36**	**40**	**45**	**50**
Cross Sectional area	380.3	491.1	614.0	804.6	1018.	1257.	1591.1	1964.30
Mass / Weight in Kg	2	3.850	4.830	6.310	7.990	9.850	12.500	15.420

No allowance shall be made/ be measured in the weight for rolling margin. If weight of bar(s) found to be more than the standard weights, the measurement / payment shall be restricted to the standard weights as above. However, if weight of bar(s) found to be less than the standard weights (but within the permissible limit), the measurements / payment for the same shall be as per standard weights.

Only authorized laps shall be measured. The cost of steel used by the contractor in the reinforcement of beams, slabs and columns etc. will be paid as per the rate of reinforcement only upto the extent shown in the drawings. As far as possible laps in bars shall be avoided. Any laps and hooks provided by the contractor other than authorised as per approved bar bending schedule will be considered to have been provided by the contractor for his own convenience and shall not be measured for payment. Pins, chairs, spacers shall be provided by the contractor wherever required as per drawing and bar bending schedule and as directed by the Engineer-in-Charge and shall be measured for payment. Fan hooks as required shall be provided by the contractor under this item and shall be measured for payment.

The rate shall include the cost of all materials and labour required for all above operations including transport, wastage, straightening, cutting, bending, binding and the binding wire required.

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7. PILE FOUNDATION

(TECHNICAL SPECIFICATIONS FOR BORED CAST-IN-SITU R.C.C. PILES)

7.0. SCOPE :

This specification covers the design and construction of load bearing concrete bored cast-in-situ piles of appropriate diameter which can transmit the load of the structure to the soil by both resistance developed at the tip by end bearing and along the surface of the pile shaft by friction.

This specification also covers the design and construction of R.C.C. pile caps and plinth beams appropriate for the piles offered and structure to be supported.

Tenderer shall be responsible for the construction of the entire pile foundation system as proposed as per drawing and schedule /soil report recommendations and shall guarantee the stability of the pile foundation system offered against the risks of settlement and other type of damage to the structure.

The Tenderer shall submit his offer as per BOQ/ schedule of Quantities, specifications and drawings.

7.1. EQUIPMENT & ACCESSORIES :

The equipment and accessories shall depend on the type of bored cast-in-situ piles chosen for the job and shall be selected giving due consideration to the sub-soil strata, ground water conditions, type of founding materials and the required penetration, manner of operation etc. For Bored cast-in-situ piles percussion boring by suitable drilling rigs using direct mud circulation (DMC) methods is to be adopted and the size of the cutting tool shall not be less than the diameter of the pile by more than 75mm Bentonite shall be used as drilling mud and its basic properties shall conform to Appendix - `A' of I.S. 2911 (Part-I/Section-2) 1987. Tremie shall be used for placing concrete into the bore holes.

7.2. GENERAL CONSIDERATIONS :

The construction of pile foundation shall be in such a way that the load from the structure it supports, can be transmitted to the soil without causing any soil failure & without causing such settlement, differential or total under permanent transient loading as may result in structural damage and/or functional distress to the buildings.

When working near the existing structures, any damage to such structures shall be made good at no extra cost. The contractor shall, therefore, take adequate care to avoid any damage to the existing structures.

In case of deep excavations adjacent to piles proper shoring or other suitable arrangement shall be done at no extra cost to guard against the lateral movement of soil or releasing the confining soil stress.

As per loading details, piles will be required to withstand vertical load axial or otherwise and horizontal load associated with moments. Axial load from a pile should be transmitted to the soil through skin friction along the shaft and end-bearing at its tip. A horizontal load shall be transmitted to the sub-soil by horizontal sub-grade reaction generated in the upper part of the pile shaft.

Coarse Aggregate, Fine Aggregate & Water:

Coarse aggregate fine aggregate and water shall conforming to IS 456 (L.R) and I.S 383 (L.R)

Concrete : Concrete to be used for the pile shaft shall be M 20. Materials and method of manufacture for cement concrete shall, in general, be in accordance with the method of concrete under the condition of pile installation. Consistency of concrete mix for cast-in-situ piles shall be suitable to the method of installation of piles. Concrete mix shall be so designed as to have a homogeneous mix having a flowable character consistent with the method of concreting of pile. The slump of concrete shall range between 100 to 180 mm depending on the method/manner of concreting. Minimum cement content shall be 400 kg per cubic metre. In case of piles where concreting is done under water or drilling mud using methods other than tremie 10% extra cement over that required for the design grade of concrete at specified slump shall be used subject to a minimum quantities of cement specified above. Cost of excess cement over the minimum quantity specified shall be borne by the contractor. For mix design, manufacture, placing etc. specification for cement concrete given hereinafter shall be referred.

7.3. WORKMANSHIP :

a) **Control of piling installation:** Bored cast-in-situ piles shall be installed by employing suitable drilling rigs using a combination of bailer and a suitable chisel with DMC method. Bore hole shall be stabilised by bentonite as drilling mud and concreting shall be done by use of tremie.

b) **Control of Alignment :** Piles shall be installed as accurately as possible as per the designs and drawings. Greater care should be exercised in respect of installation of single pile or piles in two pile groups. The piles shall be installed vertically with tolerance as stipulated by I.S 2911 (Part-I/Section-2) (Latest revision). Piles shall not deviate more than 75mm or D/6 whichever is less in case of piles having diameter less than 600mm, 75 mm or D/10 whichever is more in the case of piles having diameters more than 600mm from their designed positions at the working level. In the case of a single pile in a column, positional tolerance should not be more than 50mm or D/6 which ever is less (100 mm in case of piles having diameter more than 600 mm). In case of piles deviating beyond these limits, contractor shall carry out necessary remedial measures duly approved by the E.I.C at no extra cost. Piles that are deviated to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap or plinth beams, the piles should be re-placed or supplemented by one or more additional piles at no extra cost.

A minimum length of two/three metres of temporary guide casing upto piling platform shall be inserted in each bored pile after completion of bailer driving.

Additional length or temporary casing may be used depending on the condition of the strata, ground water level etc.

c) **Founding Level :** The bore hole shall be advanced by chisel and direct mud circulation method after installation of guide casing till the required founding level is reached. The founding level shall be as per the drawings and as directed by the Engineer-in-Charge.

In case, drilling mud within the hole stabilizes a bored pile, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. The cleaning of the hole shall be ensured by careful operation of boring tool and/or flushing of the drilling mud through the bottom of the hole by tremie for half an hour minimum.

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, wherever practicable, be determined by suitable, slurry sampler and recorded. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concreting 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 bentonite slurry is more than 1 .2.

In addition to the normal precautions to be taken in tremie concreting, the following requirements shall be applicable to the use of tremie concrete in piles:

i) The concrete should be coherent, rich in cement (not less than 400 kg/cum) & of slump not less than 150mm.

ii) When concreting is carried out under water, a temporary casing should be installed to the full depth of the bore hole or 2 to 3 M into the top stratum, so that fragments of ground cannot drop from the sides of the hole into the concrete as it is placed.

iii) The hopper & tremie should be a closed system embedded in the placed concrete, through which water can't pass.

iv) 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.

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

vi) 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 piles.

vii) 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 of concrete already placed, the pile so cast may be rejected.

In case of withdrawal of tremie out of the concrete either accidentally or to remove a choke in the tremie, the tremie may be reintroduced 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 150mm 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 buried by about 60 to 100 cm, concreting may be resumed.

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

The top of concrete in a pile shall generally be brought above the cut-off level, upto ground 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. When concrete is placed by tremie method, concrete shall be cast to the piling platform level at ground level to permit overflow of concrete for visual inspection.

d) **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 without any extra cost . 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 maybe 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.

7.4. ROUTINE LOAD TEST :

The contractor shall be required to carry out routine load tests as directed by the Engineer-in-charge on an individual pile or on a group of piles or on both. The routine load tests shall be carried out generally as per IS 2911 (Part-IV) – 1985. Report on routine load tests shall be submitted in an approved format for E.I.C approval at no extra cost. In case the tests on the routine piles reveal safe capacity less than specified, the contractor shall, at his own cost, provide suitable modifications to the pile or other remedial measures after obtaining approval of the Engineer-in-Charge. In case of an unsatisfactory results being revealed on any routine tests it shall be the contractor's responsibility to carry out additional routine tests, at his own cost till the criteria laid down are fulfilled.

Rate for routine load test shall be inclusive of providing kentledges, making other arrangements for the test loading platforms, providing tools and plants, equipments like hydraulic jack, dial gauges etc. other measuring instruments and all labour involved in carrying out tests.

7.5. MODE OF MEASUREMENT OF PILES :

The piles shall be measured in running metres from the pile cut-off level to the founding level. The rates quoted for piling work shall include the cost of concrete, hire charges of tools and plants, bailing out of water, breaking of pile heads to required level and shape, breaking, cutting through and removing the boulders or any other obstructions, if met with before reaching the required founding level etc. completed.

7.6. GUARANTEE FOR THE PILE FOUNDATION SYSTEM :

The contractor shall guarantee the stability of the pile foundation system and against risks of settlement and against all damages caused to building erected on the pile foundation system for a period of 5(five) years from the certified date of completion. Certificate of completion shall be issued by the Engineer-in-Charge after the satisfactory completion of the job.

NOTE: Proforma for guarantee to be executed by contractors for stability of pile foundation system against risk of settlement & other type of distress to the building(s) is attached in this book as **Appendix – "D".**

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8. READY MIX CONCRETE :

(SPECIFICATIONS FOR READY MIXED CONCRETE, CONFORMING TO IS 4926)

8.1. Ready mix Concrete shall conform to latest revision of IS : 4926 followings are the requirement for supply of R.M.C

8.1.A. Concrete delivered at site shall be in a plastic condition and requiring no further treatment before being placed in the position in which it is to set and harden

8.1.B. The process of continuing the mixing of concrete at a reduced speed during

transportation to prevent segregation.

8.1.C. Truck mounted equipment designed to agitate concrete during transportation to the site of delivery.

8.1.D. Concrete produced by completely mixing cement, aggregates, admixtures if any and water at a stationary central mixing plant and delivered in containers fitted with agitating devices. The concrete may also be transported without being agitated as a special case and as requested.

8.1.E. Concrete produced by placing cement, aggregates and admixtures, if any other than those to be added with mixing water, in a truck mixer at the batching plant , the addition of water and admixtures to be added along with mixing water, and the mixing being carried out entirely in the truck mixer either during the journey or on arrival at the site of delivery. No water shall be added to the aggregate and cement until the mixing of concrete commences.

8.2. MATERIALS :

8.2.A. **The cement** used shall be of specified grade ordinary Portland cement or low heat Portland cement conforming to IS: 269 or Portland slag cement conforming to IS: 455 or Portland-pozzolana cement conforming to IS: 1489 or rapid hardening. Portland cement conforming to IS: 8041 as may be specified at the time of placing the order. If the type is not specified, ordinary Portland cement shall be used.

8.2.B. **Fly ash** when used for partial replacement of cement, shall conform to the requirements of IS-3812 (Part I) and as specified by the users.

8.2.C. **The aggregate** shall conform to IS: 383. Fly ash when used as fine aggregate shall conform to the requirements of IS 3812 – (Part - II).

8.2.D. **Water** used for concrete shall conform to the requirement of IS 456-2000.

8.2.E. **The admixtures** shall conform to the requirements of IS : 456-2000 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS : 3812 (Part II) – 1981. However, partial replacement of cement by fly ash shall not be more than 15% of designed requirement.

In case if fly ash is used more than 15%, the same shall be guided under table 5.1 of the IS, and in which case specific care shall be taken in terms of curing, protecting, repairing, finishing, de-shuttering etc. as detailed in the Chapter “FLY ASH CONCRETE”, here in after.

8.3. SUPPLY :

The ready-mixed concrete shall be manufactured and supplied on either of the following basis :

i) Specified strength based on 28-day compressive strength of 15 -cm cubes tested in accordance with IS : 456-2000.

ii) Specified mix proportion.

NOTE : Under special circumstances and as specified the strength of concrete in (a) above may be based on 28-day or 7-day flexural strength of concrete instead of compressive strength of 15-cm cube tested in accordance with IS : 456-2000.

8.3.A. When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the manufacturer and the concrete shall conform to the requirements specified.

8.3.B. When the concrete is manufactured and supplied on the basis of specified mix proportions, the responsibility for the design of the mix shall be that of the purchaser and the concrete shall conform to the requirements specified.

8.4. GENERAL REQUIREMENTS:

8.4.A. When a truck mixer or agitator is used for mixing or transportation concrete, no water from the truck-water system or from elsewhere shall added after the initial introduction of the mixing water for the batch, when no arrival at the site of the work, the slump of the concrete is less that specified, such additional water to bring the slump within limits shall be injected into the mixer under such pressure and direct flow that the requirements for uniformity specified.

8.4.B. Unless otherwise specified when a truck or agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within 1 ½ hour (when the prevailing atmospheric temperature above 20^0C) and within 2 hours (when the prevailing atmosphere temperature is at or below 20 0C) of adding the mixing water to the mix of cement and aggregate or adding the cement to the aggregate which ever is earlier.

8.4.C. The temperature of the concrete at the place and time of delivery shall be not less than 5^0C. Unless otherwise required by the purchaser, the concrete shall be delivered when the site temperature is less than 2.5^0 C.

8.4.D. Adequate facilities shall be provided by the manufacturer/supplier to inspect the materials used the process of manufacture and methods of delivery of concrete. He shall also provide adequate facilities to take samples of the materials used.

8.4.E. The tests for consistency or workable shall be carried out in accordance with requirements of IS 1199 by such other method as may be agreed to between the purchaser and manufacturer.

8.4.F. The sampling and testing of concrete shall be done in accordance with the relevant requirements of IS 456, IS 1199 and IS 516.

8.4.G. The compressive strength and flexural strength tests shall be carried out in accordance with the requirement of IS: 516 and the acceptance criteria for concrete whether supplied on the basis of specified strength or on the basis of mix proportion, shall conform to the requirements and other related requirements of IS: 456 -2000.

8.4.H. The testing shall be carried out in accordance with the requirements and the cost shall be borne by the Contractor.

8.4.I. The manufacturer shall keep batch records of the quantities by mass all the solid

materials, of the total amount of water used in mixing and of the results of all tests. If required insisted, the manufacturer shall furnish certificates, at agreed intervals, giving this information.

8.4.J. Mode of measurement for ready mixed concrete (RMC) will be the same as mode of measurement for concrete work already mentioned .However, consumption of RMC shall be maintained at site. Wastage, spillover, wastage due to pump blockage etc. shall not be considered for payment.

* * * *

9. FLY ASH CONCRETE
NOTES:

a) The fly ash should have consistent quality satisfying the requirements of Grade-1 FA of IS 3812 and Class-F of ASTM C-618.

b) The source of fly ash should be so selected that test results of fly ash samples collected from these sources during last one year at frequency of maximum one month interval should satisfy the requirements of above codes.

c) The characterization of fly ash which will be used should be done as per above two codes for each batch of fly ash.

d) The fly ash should be stored in bins at the plant.

e) All concrete should be manufactured at RMC plant.

f) The mix proportion should be approved by competent authority. The information to be supplied for approval would be identified by the competent authority.

g) Any change in mix proportion, after approval, should be concurred by appropriate authority.

h) Samples to be taken, at each time of casting, for 7 days and 28 days.

i) All ingredients of concrete should satisfy the requirements of relevant IS codes and specifications.

9.1.0. <u>Curing, Protecting, Repairing and Finishing</u>

9.1.1. <u>Curing:</u> All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water, continuously saturated covering of sacking, canvas, hessain or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter the quality of curing water shall be the same as that used for mixing concrete.

Certain types of finish or preparation for overlaying concrete must be done at certain stages of curing process and special treatment may be required for specific concrete surface finish.

Curing of concrete made of high alumina cement and super sulphated cement shall be carried out as directed by Engineer-in-charge.

9.1.2. Curing of concrete with low water binder ratios having partial replacement of cement by pozzolanic materials.

9.1.3. The structural elements with concrete having water binder ratio less than or equal to 0.4 or partial replacement of cement by pozzolanic materials (5% or above replacement by silica fume or high reactivity metakaoline, or 15% or above by fly ash) shall be cured in two stages, initial curing and final curing.

i) The initial curing should be started not later than 3 hours or initial setting time, whichever is lower, after placement of concrete. The concrete surface exposed to environment should be covered by plastic sheet or other type of impermeable covers. The initial curing should be continued upto a minimum period of 12 hours or 2 hours plus final setting time of concrete, whichever is higher.

ii) Final curing should be done with water. It should commence immediately after initial curing and continue upto a minimum period of 14 days.

9.1.4. CURING WITH WATER

Fresh concrete shall be kept continuously wet for a minimum period of 14 days from the date of placing of concrete, following a lapse of 12 to 24 hours after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied to uniformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms . Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

9.1.5. CONTINUOUS SPRAYING

Curing shall be assured by use of ample water supply under pressure in pipes, with all necessary appliances of hose sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer-in-charge.

9.1.6. ALTERNATE CURING METHODS:

Whenever in the judgement of Engineer-in-charge, it may be necessary to omit the continuous spray method, covering of clean sand or other approved means such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. Any type of covering which would slain or damage the concrete during or after the curing period, will not be permitted. Covering shall be kept continuously wet during the curing period.

For curing of concrete in pavements, side walks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer-in-charge. Special attention shall be given to edge and corner of the slab to ensure proper protection to these areas. The

ponded areas shall be kept continuously filled with water during the curing period.

9.1.7. CURING COMPOUNDS :

Surface coating type curing compound shall be used only on special permission of Engineer-in-charge. Curing compounds shall be liquid type while pigmented, conforming to U.S Bureau of Reclamation Specification. No curing compound shall be used on surface where future blending with concrete water or acid proof membrane or painting is specified.

9.1.8. Curing Equipment: All equipments and materials required for curing shall be on hand and ready for use before concrete is placed.

9.2.0. Form Work

9.2.1. General: The form work shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts etc. complete which shall be properly designed and planned for the work. The false work shall be so constructed that up and down vertical adjustment can be made smoothly. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment or dismantling of form work.

9.2.2. Design of Form Work: The design and engineering of form work as well as its construction shall be the responsibility of Contractor. If so instructed the drawings and calculations for the design of the form work shall be submitted well in advance to the Engineer-in-charge for approval before proceeding with work, at no extra cost. Engineer-in-charge approval shall not however, relieve Contractor of the full responsibility for the design and construction of the form work. The design shall take into account all the loads vertical as well as lateral that the forms will be carrying including live and vibration headings.

9.2.3. Type of Form Work: Form work may be of timber, plywood, metal, plastic or concrete. For special finishes, the form work may be lined with plywood, steel sheets, oil tempered hard board etc. Sliding forms and slip forms may be used with the approval of Engineer-in-charge.

9.2.4. Formwork Requirements: Forms shall conform to the shapes, lines grooves and dimensions including camber of the concrete as called for in the drawings. Ample studs, water braces, straps,shores etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases, form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free form sap, shakes, loose knots, worm holes, wraps or other surface defects in contact with concrete. Faces coming in contact with concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently light to prevent loss of water and fine material from concrete.

Ply wood shall be used for exposed concrete surfaces, where called for Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face. Form work with lining will be permitted.

All new and used form lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water lightness, smoothness and cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Engineer-in-charge shall be removed from the site.

Shores supporting successive stories shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundation.

Form work, during any stage of construction showing signs of distortion of distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be entirely removed and the formwork corrected prior to placing new concrete.

Excessive construction camber to compensate for shrinkage settlement etc. that may impair the structural strength of members will not be permitted.

Forms for substructure concrete may be omitted when, in the opinion of Engineer-in-charge, the open excavation is firm enough to act as the form. Such excavations shall be slightly larger than required by the drawings to compensate for irregularities in excavation and to ensure the design requirement.

Forms shall be so designed and constructed that they can be stripped in the order required and their removal do not damage the concrete. Face form work shall provide true vertical and horizontal joints, conforming to the architectural features of the structure as to location of joints and be as directed by Engineer-in-charge.

Where exposed smooth or rubbed concrete finishes are required, the forms shall be constructed with special care so that the desired concrete surfaces could be obtained which require a minimum finish.

9.2.5. Bracings, Struts and Props: Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bracings.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of beams and under the offits of slab can be removed without disturbing the beam bottoms.

Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.

If the shuttering for a column is erected for the full height of the column, one side shall be left open and built upon sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 m or as directed by Engineer-in-charge.

9.2.6. Inspection of Form Work

Following points shall be borne in mind while checking during erection of form work and form work got approved by the Engineer-in-charge before placing of reinforcement bars.

a) Any members which is to remain in position after the general dismantling is done, should be clearly marked.

b) Material used should be checked to ensure that wrong items/rejects are not used.

c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.

d) i)The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground. ii)Sole plates shall be properly seated on their bearing pads or sleepers.

iii)The bearing plates of steel props shall not be distorted.

iv)The steel parts on the bearing members shall have adequate bearing areas.

e) Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.

f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.

g) The stacked materials shall be placed as catered for, in the design.

h) When adjustable steel props are used, they should

i) Be undamaged and not visibly bent.

ii) Have the steel pins provided by the manufacturers for used

iii) Be restrained laterally near each end.

iv) Have means for centralising beams placed in the fork heads

v) Screw adjustment of adjustable props shall not be over extended

j) Double wedges shall be provided for adjustment of the form to the required

position wherever any settlement/elastic shortening of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened/clamped down after adjustment to prevent their shifting.

k) No member shall be eccentric upon vertical member

l) The number of nut sand bolts shall be adequate.

m) Provisions of the design and/or drawings shall be complied

n) Cantilever supports shall be adequate

o) Props shall be directly under one another in multistage constructions as far as possible.

p) Guy ropes or stays shall be tensioned properly

q) There shall be adequate provision for the movement and operation of vibrators and other construction plant and equipment.

r) Required camber shall be provided over long spans

s) Supports shall be adequate, and in plumb within the specified tolerances.

9.2.7. Form Oil : Use of form oil shall not be permitted on the surface, which require painting. If the contractor desire to use form oil on the inside of form work of the other concrete structures, Mould Releasing agent of Sika/Fosroc or approved equivalent make /a non staining mineral oil or other approved oil CEMOL-35 of M/s. Hindustan Petroleum Co. Ltd may be used, provided it is applied before placing reinforcing steel and embedded parts. All excess oil on the form surfaces and any oil on metal or other parts to be embedded in the concrete shall be carefully removed. Before treatment with oil, forms shall be thoroughly cleared of dried splatter of concrete from placement of previous lift.

Any loss of water through the shuttering should be strictly prevented from placement specially for concrete mix with low water binder ratio or having partial replacement of cement by pozzoonas. In case of wooden shutter approved quality of form oil or plastic sheet can be use for this purpose.

9.2.8. Chamfers and Fillers : All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillers on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 20 x 20mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaces to the same texture as the forms to which it is attached.

9.2.8.1. Vertical Construction Joint Chamfers: Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not, permitted by Engineer-in-charge for structural or hydraulic reasons.

9.2.8.2. Wall Ties : Wire ties passing through the walls, shall not be allowed. Also

through bolts shall not be permitted. For fixing of form work, alternate arrangements such as coil nuts shall be adopted at the contractors cost.

9.2.8.3. Reuse of Forms : Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer-in-charge. Warped lumber shall be resized. Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

9.2.8.4. Removal of Forms : Contractors shall record on the drawings or a special register,the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

In no circumstances shall forms be struck until the concrete reaches a strength of the at least twice the stress due to self weight and any construction erection loading to which the concrete may be subjected at the time of striking form work.

In normal circumstances (generally where temperatures are above 200 C.) forms may be struck after expiry of the following periods.

S. N	**Part of Structure**	**Earliest concrete age at stripping**		
		Cement with low and having pozzolonas	**Ordinary Portland cement**	**Portland Pozzolana C.C Fly Ash**
a)	Walls, columns and vertical sides of beams	3 days	24 to 48 hours as directed by	3 days
b)	Slabs(Props left Under)	14 days	3 days	7 days
c)	Beam, soffits (Props left under)	14 days	7 days	10 days
d)	**Removal of props** i)Spanning upto 4.5m	14 days 14 days	7 days 14 days	10 days 14 days
e)	**Removal of props in beams & arches**	14 days 14 days	14 days 21 days	14 days 21 days
f)	For perforated 120mm thick	14 days	14 days	14 days

Skirting shall be done slowly with utmost care to avoid damage to arise and application and without shock or vibration by gently easing the wedge etc. After removing the form work, if it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provide as directed by Engineer-in-charge, to facilitate removal of form work which otherwise may be in accessible.

Tie, rods, clamps form-bolts etc. which must be entirely removed from walls or similar structures shall be loosened not sooner that 24 hours not later than 40 hours after concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties withdrawn from walls and grade beams shall be pulled towards the inside face. Cutting ties back from the faces of walls and grade beams will not be permitted. Work damaged due to premature or careless removal of forms shall be re-constructed at contractor's cost.

* * *

10. DAMP PROOF COURSE :

10.1. SCOPE OF WORK : The work covered under this specifications consists supplying and laying plain cement concrete as damp proof course with or without waterproofing admixture in accordance with this specification and applicable drawings.

10.2. WORKMANSHIP : Surface to receive damp proof course shall be cleaned and carefully swept to remove all dust, laitance etc. and shall be approved by the Engineer-in-Charge. Damp proof course shown shall be cement concrete as per proportion indicated in the schedule. Approved water proofing compound @ 3% by weight of cement or as directed by the manufacturer shall be mixed in cement mortar for this concrete. The damp proof course shall be laid to the full width of the wall and the edges shall be straight, even and truly vertical. Wooden forms shall be used to obtain good edges. No masonry work shall be commenced on freshly laid damp proof course unless it is cured for 48 hours of its laying but the curing of cement concrete shall be continued along with the masonry work. Specifications for cement, sand, aggregate and water shall be as described herein before for concrete works.

10.3. MODE OF MEASUREMENT : The work shall be measured in Sqm. area actually laid limited to sizes as shown in drawing. The rate shall include cost of all the materials, labour etc.

* * *

11. PRECAST REINFORCED CEMENT CONCRETE JALLI :

GENERAL :

The item refers to manufacturing, supplying and fixing in position reinforced cement concrete jalli with thickness, proportion, design and pattern as specified in the description of item of schedule of quantities.

MATERIALS :

The concrete shall consist of a mix as specified in the item and specifications for cement concrete shall be similar to that specified under cement concrete. Reinforcement shall be as specified in the item description or as shown in the drawing or as directed by the Engineer-in-charge.

MANUFACTURE :

Precast jalli of approved design and thickness as specified in description of item shall be cast at site and fixed in position at all floors and levels by the contractor. Steel moulds to manufacture approved size, design and thickness of reinforced jalli as per drawings shall be manufactured and got approved before starting large scale casting. Reinforced jalli shall be cast at site. M.S. reinforcement of 6 mm. dia. or as specified shall be bent to the exact shape of jalli to run vertically and horizontally along centre of all walls and suitably kept in position. Use of teak wood/shuttering plywood moulds can be allowed at the discretion of the Engineer-in-charge. Precast Jalli shall be made by filling the moulds of the approved design, pattern with complete batch of 1:2:2 (using 10 mm. down graded stone aggregate) cement concrete so that the entire work may set in one time. If one batch is sufficient to complete a unit, each succeeding batch should follow the preceding batch as quickly as possible. The specifications for reinforced cement concrete shall conform to I.S. 456-1964 and as specified earlier. The jalli shall be cast according to drawing, design and as approved by the Engineer-in-charge. Necessary holes and keys for M.S. dowels to house in the jalli shall be left for fixing. Jallies shall be cured in a curing tank for a minimum period of 14 days. All the imperfection in surfaces and edges shall be repaired with neat cement paste to finish with sharp and smooth edges. The jalli so manufactured shall be perfectly at right angles when checked with straight edge. Jallies which are not approved due to defective pattern, shape, finish etc. shall be removed forthwith from the site of work.

FIXING :

The jalli shall be fixed in position in cement mortar 1:2 in preformed opening true to line, level and plumb with 6 mm. M.S. pins, all as per drawing or as directed by the Engineer-in-charge. Jalli with damaged edges of surfaces shall not be fixed. The joints shall be cured for a minimum period of 7 days. After grouting the sides with cement mortar etc., the jalli shall be rechecked for its levels and alignment. Finally the jambs, sills and soffits shall be plastered embedding the jalli uniformly on sides. The jalli shall be cleaned off all the mortar splashes, dirt etc.

MODE OF MEASUREMENT:

The jalli shall be measured in square metre and shall be measured between the limiting dimensions of unplastered sides, base and top. Any portion of jalli embedded in the supporting wall shall not be measured for payment. Dimensions shall be measured correct upto two places of decimal of a metre and the area worked out upto two places of a decimal of square metre. No deduction shall be made for the openings in the jalli. The thickness shall not be less than that specified.

RATES :

Rate to include the cost of the following :

i) Providing the precast jalli of approved design conforming to specifications detailed above including concrete reinforcement, moulds etc.

ii) All materials, equipment, labour for handling, transporting, hoisting and fixing the jalli in position including scaffolding, forming grooves if necessary, touching up all sides wherever necessary as per drawing and specifications.

* * * *

12. STRUCTURAL STEEL :

SCOPE OF WORK :

The work covered by this specification consists of furnishing and erecting of structural steel complete in strict accordance with this specifications and the applicable drawings.

MATERIALS :

12.1.1. All structural steel shall be of standard sections as marked on the drawings and shall be free of scale, blisters, laminations, cracked edges and defects of any sort. The Contractor shall furnish duplicate copies of all mill orders and/ or also the test report received from the mills, for the structural steel sections to satisfy the Engineer-in-Charge.

12.1.2. All structural steel and electrodes shall comply in all respects with I.S. for structural steel.

WORKMANSHIP :

All workmanship shall be of first class quality in every respect to the greatest accuracy being observed to ensure that all parts will fit together properly on erection.

All ends shall be cut true to planes. They must fit the abutting surfaces closely. All stiffeners shall be fit tightly at both ends.

All butt ends of compression members shall be in close contact through the area

of the joints.

All holes in plates and section between 12 mm. and 20 mm. thick shall be punched to such diameter that 3 mm. of metal is left all around the hole to be cleaned out to correct size by reamer.

The base connection shall be provided as shown on drawings and the greatest accuracy of workmanship shall be ensured to provide the best connections.

Figured dimensions on the drawings shall be taken.

ERECTION AND MARKING :

Erection and fabrication shall be according to I.S. 800-2007 . During erection, the work shall be securely braced and fastened temporarily to provide safety for all erection stresses etc. No permanent welding shall be done until proper alignment has been obtained.

Any part which do not fit accurately or which are not in accordance with the drawings and specifications shall be liable to rejection and if rejected, shall be at once be made good.

Engineer-in-Charge shall have full liberty at all reasonable times to enter the contractors premises for the purpose of inspecting the work and no work shall be taken down, painted or despatched until it has been inspected and passed. The contractor shall supply free of charge all labour and tools required for testing of work.

DELIVERY AT SITE :

The contractor shall deliver the component parts of the steel work in an undamaged state at the site of the works and the Engineer-in-Charge shall be entitled to refuse acceptance of any portion which has been bent or other wise damaged before actual delivery on work.

SHOP DRAWINGS :

The shop drawings of structural steel based on contract drawings shall be submitted to the Engineer-in-Charge. The necessary information for fabrication, erection, painting of structure etc. must be furnished immediately after acceptance of the tender.

PAINTING :

Painting should be strictly according to I.S. 1477-1971 (PartI-Pretreatment) and I.S. 1477-1 971 (Part II-painting).

Painting should be carried out on dry surfaces free from dust, scale etc. The paint shall be approved by the Engineer-in-Charge. The painting system for main framework trusses,columns,steel staircase structural steel shall be Surface preparation by shot blasting & epoxy painted or as specified in the drawings & requirement of EIC. Surface preparation shall be by mechanical means for insert plates, corner angles & enamel /epoxy painted all as specified in the drawings & requirement of EIC.

One coat of shop paint shall be applied on steel, except where it is to be encased in concrete or where surfaces are to be field welded.

WELDING :

Welding shall be in accordance with I.S. 816-1969, I.S. 819-1957, I.S. 1024-1979, I.S. 1261-1959, I.S. 1323-1982 and I.S. 9595-1980 as appropriate. For welding of any particular type of joint, welders shall give evidence of having satisfactory completed appropriate tests as described in any of I.S. 817-1966, I.S. 1393-1961, I.S. 7307 (Part-I)-1 974, I.S. 7310 (Part-I)-1974 and I.S. 7318 (Part-I)-1 974 as relevant.

12.1.3. Welding Consumables : Covered electrodes shall conform to I.S. 814 (Part-I)-1974 and I.S.814 (Part-II)-1974 or I.S. 1395-1 982 as appropriate.

Filler rods and wires for gas welding shall conform to I.S. 1278-1972.

The bare wire electrodes for submerged arc welding shall conform to I.S. 7280-1 974. The combination of arc and flash shall satisfy the requirements of I.S. 3613-1 974.The filler rods and bare electrodes for gas shielded metal, arc welding shall conform to I.S. 6419-1971 and I.S. 6560-1972 as appropriate.

12.1.4. Types of Welding: Arc welding (direct or alternating current) or Oxyacetylene welding may be used. Field welding may be used. Field welding shall be by D.C.

12.1.5. Size of Electrode Runs: The maximum gauge of the electrodes for welding any work and the size of run shall be based on the following tables.

Average thickness of plate	**Maximum gauge or diameter of**
Less than 3/16"	10 S.W.G.
3/16" and above but less than	8 S.W.G.
5/16" and above but less than	6 S.W.G.
3/8" and above but less than	4 S.W.G.
5/8" and above but less than	5/1 6"dia.
1" and above thick section	3/8" dia.

Note : On any straight weld the first run shall not ordinarily be deposited with a larger gauge electrode than No. 8 S.W.G. For subsequent runs the electrode shall not be increased by more than two electrode size between consecutive runs.

12.1.6. Welding Contractors : The contractor shall ensure that each welding operator employed on fabrication or erection is an efficient and dependable welder, who has passed qualifying tests on the types of welds which will be called upon to make.

Sample test shall have to be given by the contractor to the entire satisfaction of the Engineer-in-charge.

12.1.7. Welding Procedure :

a) Welding should be done with the structural steel in flat position in a down hand manner wherever possible. Adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work. Welding plant capacity shall be adequate to carry out the welding procedure laid down. Adequate means of measuring the current shall be available either as a part of the welding plant or by the provision of a portable ammeter. In checking the welding current, a tolerance of 10% or 30 amperes from the specified value whichever is less shall be permitted.

b) The welding procedure shall be such as to ensure that the weld metal can be fully and satisfactory deposited through the length and thickness of all joints so that distortion and shrinkage stresses are reduced to the minimum and thickness of welds meet the requirements of quality specified.

WORKMANSHIP :

12.1.8. Preparation of Fusion Faces : Fusion faces shall be cut by stearing machine or gas cutting and later dressed by filling or grinding so that they shall be free from irregularities such as would interfere with the deposition of the specified size of weld to cause the defects. Fusion faces and the surrounding surfaces shall be free from heavy slag, oil paint or any substance which might affect the quality of the weld or impede the progress of welding. The welding face shall be free of rust and shall have metal shine surfaces.

The parts to be welded shall be brought into as close contact as possible and the gap due to faulty workmanship or incorrect fit up shall not exceed 1/16". If separation of 1/16" or more occurs locally, the size of the fillet weld shall be increased at such position by an amount of equal to the width of the gap.

The parts to be welded shall be maintained to their correct position during welding. They shall be securely held in position by means of tack welds, service bolts, clamps or rings before commencing welding so as to prevent and relative movement due to distortion, wind or any other cause.

12.1.9. Step Back Method Should be Used to Avoid Distortion : The minimum leg length of a fillet weld as deposited should not be less than the specified size and the throat thickness as deposited should be not less than that tabulated below:

Throat Thickness of Fillet

Angle between fusion faces	60^0-90^0	91^0-100^0	101^0-106^0	107^0-113^0	114^0-120^0
Throat thickness in	0.70	0.65	0.60	0.55	0.50

In no case should a concave weld be deposited without the specific approval of the Engineer-in-Charge unless the leg length is increased above the specified length

so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat.

All welds shall be deposited in a pre-arranged order and sequence taking due account of the effects of distortion and shrinkage stresses.

After making each run of welding, all slag shall be removed and final run shall be protected by clean boiled linseed oil till approved.

The weld metal, as deposited, shall be free from crack, slag,excessive porosity, cavities and other faults.

The weld metal shall be properly fused with the parent metal without overlapping or serious undercutting at the toes of the weld.

The surfaces of the weld shall have a uniform and consistent contour and regular appearance.

In welds containing crack, porosity or cavities in which the weld metal tends to overlap on the parent metal without proper fusion, the defective portions of the welds shall be out cut and re-welded. Where serious under cutting occurs, additional weld metal shall be deposited to make good reduction. Testing of welded joints shall be done as per relevant IS codes 3600, 3613, 4260, 7205, 7215, 7307, 7310, 7318.

MODE OF MEASUREMENT:

All structural steel shall be measured on weight basis of kgs or in metric tonnes or quintals as mentioned in the schedule of quantities. The length or areas of various members including gusset plates shall be measured correct to two places of decimals and the net weight worked out from the standard steel tables approved by Indian Standard Institution. No separate measurements shall be taken for welding, riveting, bolting, field connections etc. The rate shall include cost of all labour, materials, scaffolding, transport and also cost of welding, riveting and bolting, field connections if any all to complete the job as per specifications.

* * * *

13. BRICK WORK :.

SCOPE OF WORK :

The work covered under this specification pertains to procurement of well burnt clay bricks of class 35 unless otherwise specified and workmanship in building walls of various thickness, in strict compliance with the specifications and applicable drawings.

MATERIALS:

Brick shall be well burnt clay bricks of designated class and shall satisfy the strength criteria and shall be got approved by the Engineer-in-Charge before incorporation in the work. The bricks shall be hand moulded or machine moulded

and shall be free from nodules of free lime, visible cracks, flaws, warpage and organic matter.

In general, the nominal size of bricks (F.P.S.) shall be 22.9 x 11.4 x 7 cm. (9"x4.5"x2.75"). Permissible tolerance on dimensions shall not be more than (+/-) 8%. The contractor shall get approved the sample and source of bricks from Engineer-in-Charge before procurement on large scale and shall maintain the same for the entire work. The bricks shall have smooth rectangular faces with sharp corner and shall be uniform in colour.

Bricks for Mumbai / Pune and surrounding areas, unless otherwise specified, shall be as per relevant IS of class designation 35 of size 22.5 x 11.1 x 7 cm. Permissible tolerance on dimensions shall not be more than (+/-) 8%.

Unless otherwise specified, bricks for Eastern Zone works (Kolkata / Bhubneshwar / Shillong etc.) shall be of class designation 75 of size 25 x 12.5 x 7.5 cm. Permissible tolerance on dimensions shall be as per relevant IS.

In case the size of bricks used in the work is found lesser than the specified one but within the permissible tolerance i.e. {-} 8% , the following shall apply:

i. Extra cement consumed due to more number of joints and due to additional thickness of plaster than the specified in the tender to match with adjoining columns and beams, shall be borne by the contractor without any extra cost .

ii. If the plastering to be done is more than the specified thickness to maintain the plaster surface to perfect line, level and plumb with adjoining columns, beams, walls etc., the contractor shall be responsible to provide more thickness of plaster at his own cost and nothing extra will be paid on this account.

In case the size of bricks used in the work is found more than the permissible, the contractor shall chip out the exposed edges of bricks upto the required level of wall to receive specified thickness of plaster.

Bricks shall generally conform to I.S. 1077-1992. In any case minimum crushing strength shall not be less than 35 kg/cm^2 and water absorption shall not be more than 25% by weight. The Engineer-in-Charge shall have the right to reject bricks obtained from any field where the soil has an appreciable quantity of sulphates and chlorides. The specifications for cement, sand and water shall be same as described herein before under cement concrete. Bricks shall be thoroughly soaked in water before using till the bubbles ceases to come up. No half or quarter brick shall be used except as closer. The closer shall be cut to required size and used near the end of the walls. The walls shall be raised truly to plumb. The type of bond to be adopted shall be decided by the Engineer-in-Charge, but vertical joints shall be laid staggered.

WORKMANSHIP :

Four courses of brick work with four joints should not exceed by more than 40 mm., the same bricks piled one over the other without mortar.

Brick work shall not be raised more than 10 courses a day unless otherwise approved by the Engineer-in-Charge. The brick work shall be kept wet for at least 7 days. Brick work shall be uniformly raised alround and no part shall be raised more than 1.0 metre above another at any time.

All joints shall be thoroughly flushed with mortar of mix as specified in the schedule of quantities, at every courses. Care shall be taken to see that the bricks are bedded effectively and all joints completely filled to the full depth.

The joints of brick work to be plastered shall be raked out to a depth not less than 10 mm. as the work proceeds. The surface of brick work shall be cleaned down and watered properly before the mortar sets.

The adhesion between the brick masonry surface and the concrete surface of columns, beams, chajjas, lintels etc. should be proper by ensuring that the concrete surface coming in contact with brick masonry is hacked/ chipped/ keyed, cleaned and cement slurry is applied so that a proper bond is achieved between the two dissimilar materials. It is the responsibility of the contractors to ensure that there will not be any cracks/ fissures anywhere in the brick masonry.

In case the cracks appear subsequently in those areas, they should be made good by cement grouting or epoxy putty grouting/ poly sulphide compound grouting or as per standard modern specifications/ methods with the prior approval of the Engineer-in-Charge, at the cost of the contractor.

All the courses shall be laid truly horizontal and all vertical joints shall be truly vertical. Specified mortar of good and approved quality shall be used. Lime shall not be used where reinforcement is provided in brick work. The mortar should completely cover the bed and sides of the bricks. Proper care should be taken to obtain uniform mortar joint throughout the construction. the walls should be raised uniformly in proper, approved bond. In construction of the wall, first of all two end corners are carefully laid to line and level and then in between portion is built, with a cord stretching along the headers or stretchers held in position at the ends. This helps in keeping the alignment of the courses and maintaining them in level. Similarly all other courses are built. Care shall be taken to keep the perpends properly aligned within following maximum permissible tolerances :

a. Deviation from vertical within a storey shall not exceed 6 mm per 3 m height.

b. Deviation in verticality in total height of any wall of building more than one storey in height shall not exceed 12.5mm.

c. Deviation from position shown on plan of any brick work shall not exceed 12.5 mm.

d. Relative displacement between load bearing wall in adjacent storeys intended to be vertical alignments shall not exceed 6 mm.

e. A set of tools comprising of wooden straight edge, masonic spirit levels, square, 1 meter rule line and plumb shall be kept on the site of work for every 3 masons for proper check during the progress of work.

No brick work shall be carried on during frosty weather except with the written permission of the Engineer-in-Charge, who will give special directions as to the manner in which the work is to be performed. All brick work laid during the day, shall, in seasons liable to frost, be properly covered up at night as directed by the Engineer-incharge. Should any brick work be damaged by frost, the brick work shall, at the discretion of the Engineer-in-Charge, be pulled down and made good, at the cost of the contractor.

Concrete surfaces of columns, beams, lintels, chajjas etc. coming in contact with masonry work shall be include wire brushing and cleaning brickwork covered with fungus or deleterious materials.

Brick work shall be well watered/ cured throughout the day for at least a week from the date of building and the work shall be protected from sun and rain.

HALF BRICK WORK:

Materials and workmanship for a half brick or brick on edge partition wall shall be as specified above. The wall shall be stiffened by R.C.C. stiffeners of size 115 mm. wide x 80 mm. thickness to the full length of wall and shall be provided with 2 Nos. 6 mm. diameter M.S. bars or as specified in the schedule as bottom reinforcement (only the M.S. reinforcement will be paid separately under relevant item). These bars shall be securely anchored at their end where the partition end. The free ends of the reinforcement shall be keyed into the mortar of the main brick work to which the half brick work is joined. Overlaps in reinforcement, if any, shall not be less than 30 cm.

The rates for brick work shall include the cost of the following:

i. Providing and fixing necessary single or double scaffolding and removing the same after the work is completed.

ii. Form work for stiffeners concrete as required.

iii. Watering, curing, lifting of materials to any height.

iv. Raking out of joints to receive plaster.

v. Forming slab sittings, cutting or leaving holes for lugs of windows, doors, sills, switch boxes etc.

vi. Making good all holes, chases, etc. to any depth due to conduit pipes, holdfasts, bolts, switch & plug boxes etc.

vii. Bedding and pointing precast lintels, sills etc. in or on walls. For the purpose of measurements, the thickness of one brick wall and over shall be taken in terms of multiples of half brick.

SAMPLING AND TESTS:

Samples of bricks shall be subjected to the following mandatory tests :

a) Dimensional tolerance b) Water absorption c) Efflorescence d) Compressive strength

Note : 1. Cost of above tests shall be borne by the contractor.

2. Frequency of test shall be as per relevant IS specifications.

MODE OF MEASUREMENT :

13.5 a) For Brick Work Measured in Cubic Metres :

The contract rate shall be for a unit of one cubic metre of brick masonry as actually done. 230 mm. thick (or as specified in schedule) brick walls shall be taken as one brick thick.

All openings in brick work for doors, windows and ventilators shall be deducted to get the net quantity of actual brick work done.

Openings or chases required for P.H. or electrical inserts less than 0.1 sqm. and bearing of precast concrete members shall not be deducted.

No extra payment shall be made for any extra work involved in making the above openings or placements.

13.5 b) For brick work measured in square metre :

Half brick thick masonry walls shall be measured in sqm. All openings in brick work for doors and windows and ventilators shall be deducted to get the net quantity of actual work done. Openings or chases required for P.H. or Electric inserts less than 0.1 sqm. and bearing of precast concrete members shall not be deducted. No extra payment shall be made for extra work involved in making the above openings or placements.

* * *

14. STONE MASONRY :

SCOPE OF WORK :

The work covered under this specifications consists of supplying and erecting stone masonry walls with available best quality of stone in strict compliance with this specifications and applicable drawings.

RANDOM RUBBLE MASONRY :

14.1.1. Material : The rubble shall be of the best quality trap/granite/ballast stones obtained from the approved quarry. The sample of the stone, to be used shall be got approved from the Engineer-in-Charge. All stones shall, generally, be freshly quarried and shall be sound, dense, hard, free from segregation, cracks, weathered portions and other structural defects or imperfections, tending to off set soundness and strength. The percentage of water absorption shall generally not exceed 5% by weight. All stones shall be wetted before use. Stones shall be neatly worked to requisite sections and forms and shall have fully dressed beds and joints. At least

50% of the stones shall be 0.015 cum in content when reckoned individually. The length of stones for stone masonry shall not exceed three times the height and the breadth or base shall not be greater than three fourth the thickness of wall, or not less than 15 cm. The height of stone may be upto 30 cm. Stones shall be laid on the natural beds and shall run sufficiently inside the wall thickness. No hollow space shall be left out and inter spaces of stones being filled with mortar and stone chips, driven hard & not with mortar only.

All mortar to be used shall be of the type and proportion mentioned in the item. Cement, sand and water to be used shall conform to their relevant specifications as described under cement concrete. The masonry shall be laid to plumb, lines levels, curves, shapes as shown in drawings. All required holes for passage of water or pipes are to be embedded during construction as specified.

All stones shall be wetted before laying in masonry. Concrete surfaces of columns, beams, lintels, chajjas etc. coming in contact with masonry shall be properly chipped, washed and wetted before start of masonry work. The concrete surface coming in contact of masonry shall be given a thick coat of cement slurry as the masonry work progresses in height. Clean chips and sprawls carefully selected to fit in the space shall be wedged into the mortar joints and beds wherever necessary to avoid thick beds or joints or mortar. However, proper shaping and dressing of stones shall be done prior to their laying in masonry and hammering shall not be resorted to often after the stones are laid in position. The bond stones shall be used in every square meter area of masonry wall and shall extend from front to back to thin walls having width of 600mm and shall overlap by at least 150mm in walls having thickness more than 600mm when laid from both sides. Engineer-in-Charge may permit cement concrete 1:2:4, in-situ / pre-cast, to act as bond stone, as required. When the work has to be started on the old or the one completed a long while ago or in the previous working seasons, care shall be taken to roughen and clean old surface satisfactorily without disturbing the masonry before laying the new. It shall be wetted before laying the bedding mortar.

When practicable, the whole masonry in any structure shall be carried out upto a uniform level throughout. But when breaks are unavoidable in carrying the work continuously in uniform level, sufficiently long steps shall be left. All junction of walls shall be formed at the time when walls are being built. Cross walls should be carefully bonded into the main walls. All masonry built in cement mortar shall be kept continuously wet for 14 days from the date of laying. Should the mortar perish i.e. becomes dry, white or powder through neglect of watering and if the masonry shows hollow joints or non adherence of mortar to the stones or if the work does not conform to drawings and specifications, the work shall be pulled down and rebuilt by the contractor at his own cost and risk. All masonry shall be thoroughly cleaned and washed down on completion and all stains, adhering mortar removed from the surface and raking of joints carried out as the scaffolding is being lowered and removed. Holes left in masonry for supporting scaffolding shall be filled and made good before pointing/ plastering.

KHANDKI FACING STONE MASONRY :

The specifications for Random rubble masonry as given in item No. 14.2 shall generally apply to these for quality of stones, workmanship etc. except for the following:

The face of the stones shall be square/ rectangular in shape and shall be so dressed alround that those can be set on proper bases and shall render uniform joints. The stones may have bushing on the face but shall not project more than 40 mm. The external faces shall be laid in courses of about 200 mm. height or as specified and the internal face shall be finished with rubble backing.

The other specifications, mode of measurements etc. shall be same as per specifications for R.R. Masonry mentioned above.

MODE OF MEASUREMENT :

All stone masonry shall be measured in cubic metres as actually done. All openings for windows, doors, lintels etc. shall be deducted to get the net quantity of actual work done. Openings or chases required for P.H. and electrical inserts less than 0.1 sqm. and bearings of precast concrete members shall not be deducted. The rate shall also include cost of corner stones, bond stones, scaffolding ,labour, curing etc.

* * * *

15. PRECAST CEMENT CONCRETE SOLID BLOCK MASONRY:

Scope of Work : The work covered under this specifications pertains to procurement of best quality locally available or locally manufactured precast cement concrete solid block and workmanship in building walls of various thickness in strict compliance with the specifications and applicable drawings.

Material : Precast cement concrete solid blocks shall be of best quality locally available/ manufactured at site and should be approved by the Engineer-in-Charge before incorporation in the work. The ingredient and the cement concrete used shall confirm to relevant I.S. as stipulated in specification for cement concrete works herein before.

Minimum crushing strength of the solid blocks shall be 40 to 60 Kg/ sqcm. at 28th day after curing. The type of the bond to be adopted will be decided by the Engineer-in-Charge but vertical joints shall be staggered. The size of the blocks shall be 390 x 190 x 140 mm. and 390 x 190 x 100 mm. and the proportion used in making the blocks shall be 1:11 (1 cement : 11 fine and coarse aggregates). The blocks shall be cured well at least for 14 days before incorporation in to the work. The cement mortar for concrete blocks masonry shall be 1:4 and joints shall not be more than 10 mm. thick.

Workmanship and Mode of Measurement : The workmanship and mode of measurement shall be as stipulated in the specification for brick work as applicable stated earlier and concrete block masonry with 140 mm. thick block shall be measured in sqm. nearest to two places of decimals of a metre. The rate quoted shall include cost of all materials, labour including form work in casting the blocks, curing, transporting, handling, hoisting the blocks to proper level, curing masonry etc. complete.

* * *

16 CEMENT CONCRETE FLOORING (IPS) :

SCOPE OF WORK :

The work covered under this specification consists of providing and laying at all levels and floors, flooring of different types, strictly in accordance with these specifications and relevant drawings.

CEMENT CONCRETE FLOORING (INDIAN PATENT STONE) :

Materials : The specifications for materials, grading, mixing and the quantity of water to be added shall generally conform to their relevant specifications described under plain and reinforced concrete. The maximum size of coarse aggregate shall be 10 mm. The fine aggregate shall consist of properly graded sand. Concrete shall be mixed preferably by machine, and hand mixing shall be avoided as far as practicable.

Preparation of Base : The base concrete surface shall be thoroughly chipped to remove laitance, caked mortar, loose sand, dirt etc. cleaned with wire brush and washed clean and watered until no more water is absorbed. Where the base concrete has hardened so much that roughening the surface by wire brushes is not possible, the same shall be roughened by chipping or hacking at close intervals. The surface shall be soaked with water for at least 12 hours and surface water removed and dried before laying the topping. Before laying the concrete, cement slurry at 2.75 kg./ sqm. of surface shall be applied for better bond. Concrete flooring shall then be laid in alternate bays in pattern and joints, wide/ flush as per drawing. The edge of each panel into which the floor is divided shall be supported by wooden or metal strips duly oiled to prevent sticking. The panels shall be of uniform size and, unless otherwise specified, no dimension of panel shall exceed 2 m. and the area of a panel shall not be more than 2 sqm. However, the exact size of panel shall be decided by the Engineer-in-Charge to suit the size of the room. The joints in the floor finish shall extend through the borders and skirting/dado. The border shall have mitred joints at the corners of the room. Where glass/ aluminium dividing strips are proposed to be provided, the same shall be fixed in cement mortar 1:2 @ 600 mm. centres or as specified in the schedule for full depth of the finished floor.

The depth of dividing strips shall be the thickness as proposed for the finished floor in the item. In the case of flush joins, alternate panels only may be cast on same day. At least 48 hours shall elapse before the concreting of adjacent bay is commenced.

Mixing : The topping concrete shall be of mix of one part of cement, two parts of sand and 4 parts of well graded stone chips of 10 mm. maximum size. The ingredients shall be thoroughly mixed with just sufficient water to the required plasticity, having water cement ratio not more than 0.4.

Laying : The free water on the surface of the base shall be removed and a coat of cement slurry to the consistency of thick cream shall be brushed on the surface. On this fresh grouted base, the prepared cement concrete shall

be laid immediately after mixing. The concrete shall be spread evenly and laid immediately after mixing. The concrete shall be spread and levelled carefully. The concrete shall be completed and brought to the specified levels by means of a heavy straight edge resting on the side forms and down ahead with a sawing motion in combination with a series of lifts and drops alternatively with small lateral shifts, either mechanically or manually as directed by the Engineer-in-Charge.

While concreting the adjacent bays, care shall be taken to ensure that the edges of the previously laid bays are not broken by carelessness or hand 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 and whole surface is again levelled. When the layer is made even, the surface shall be completed by ramming or beating and then screed to a uniform line and level. Before the initial set commences, the surface shall be trowelled to 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 or empty gunny bags spread over the surface of the concrete to absorb excess water coming on top due to floating.

Finishing the Surface : After the concrete has been fully compacted, it shall be finished by trowelling or floating. Finishing operations shall start shortly after the compaction of concrete and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled intermittently at intervals for several times so as to produce a uniform and hard surface. The satisfactory resistance of floor to wear depends largely upon the care with which trowelling is carried out. The object of trowelling is to produce as hard and close knit a surface as possible. The time interval allowed between successive trowelling is very important. Immediately after laying only just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this tends to work a layer rich in cement to the surface, some time. After the first trowelling, the duration depending upon the temperature, atmospheric conditions and the rate of setting of cement used, the surface shall be retrowelled many times at intervals to close any pores in the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trowelled back into the topping). The final trowelling shall be done well before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface. Trowelling of rich mix of dry cement and fine aggregate on to the surface shall not be permitted. Trowel marks should not be seen on the finished surface.

Where broom finish is specified, after the concrete has been thoroughly compacted, and when most of the surface water has disappeared, the surface shall be given broom finish with an approved type of brass or M.S. fiber. The broom shall be pulled gently over the surface from edge to edge in such a manner that corrugation shall be uniform in width and depth, the depth shall be not more than 1.5 mm. Brooming shall be done when the concrete is in such a condition that the surface will not be torn or unduly roughened by the

operation. Coarse or long bristles which cause irregularities or deep corrugation shall be trimmed out. Brooms which are worn or otherwise unsatisfactory shall be discarded.

After the concrete in the bays has set, the joints of the panels should be filled with cement cream and neatly floated smooth or jointed. Care should be taken that just the minimum quantity of cream for joint is used and excess spilling over the already finished surface shall be removed when the cream is still green.

In case of wide joints the same shall be filled with pigmented cement concrete (1:2:4) using approved pigment and the joint shall be finished in perfectly straight line.

Steel Trowel Finish : Areas where Marblex tiles are proposed to be used are required to have base concrete finished smooth by steel trowel.

Curing : The completed flooring shall be protected from sun, wind and rain for the first two days and movement of persons over the floor is prohibited during this period. The finished surface shall be covered and cured continuously form the next day after finishing, at least for a period of 7 days. Bunding with murrum for curing is prohibited as it will leave permanent stain on the finished floor.

Curing shall be done by spreading sand and kept damp throughout the curing period of seven days minimum. The surface shall be protected from any damage to it whatsoever. The surface shall then be allowed to dry slowly. All corners, junctions of floor with plastered wall surface shall be rounded off when required at no extra cost.

Mode of Measurement : The rate for flooring and skirting shall be in square metre of the area covered.

The length and width of the flooring shall be measured net between the faces of skirting or dado or plastered faces of walls which is the proudest.

All openings in flooring exceeding 0.1 sqm. in area where flooring is not done shall be deducted and net areas only shall be measured and paid for. Flooring under dado, skirting or plaster shall not be measured for payment.

Nothing extra shall be paid for laying the floor at different levels in the same room.

The dimensions shall be measured upto two places of decimals of a metre and area worked out upto two places of decimal of a square metre.

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17. IRONITE (OR HARDONATE) FLOORING.

17.1. GENERAL :

To withstand heavy wear and tear, concrete flooring with metallic concrete hardening compound such as Ironite/ hardonate shall be laid as wearing layer as detailed below:

17.2. METALLIC / NON METALLIC CONCRETE HARDENING COMPOUND :

The metallic compound shall be Non Metallic / Ironite/ Hardonate of approved quality consisting of uniformly graded iron particles, free from non-ferrous metal particles, oil, grease and soluble alkaline compound.

17.3. CEMENT CONCRETE UNDER LAYER :

Cement concrete flooring of specified thickness and mix shall be laid as specified and generally conforming to specifications laid down for cement concrete flooring. The top surface shall be roughened with brushes while the concrete is still green and the form shall be kept projecting up 12 mm. over the concrete surfaces, to receive the metallic hardening compound topping.

17.4. METALLIC / NON METALLIC CONCRETE HARDENER TOPPING :

This shall consist of 12mm. thick layer of mix 1:2 (1 part of cement mixed with hardener: 2 parts of stone aggregate of 6 mm. nominal size by volume). The metallic / Non Mettalic concrete hardener compound being mixed with cement in the ratio of 1:4 (1 metallic concrete hardener: 4 cement used by weight) or as specified by the manufacturer. Concrete hardener shall be dry mixed thoroughly with cement on a clean dry pucca platform. This dry mixture shall then mixed with stone aggregate 6mm. nominal size or as otherwise specified in the ratio of 1:2 (1 cement mixed with hardener: 2 stone aggregate) by volume, and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete, water cement ratio not exceeding 0.4.

The mixture so obtained shall be laid in 12mm. thickness, on cement concrete floor within 1 to 4 hours of its laying. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. The concrete shall be compacted well mechanically. Manual compaction will not be permitted unless approved by the Engineer-in-charge. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

17.5. CURING, PRECAUTIONS, MEASUREMENTS ETC. :

Specifications for curing, precautions, quantity measurements etc. shall be same as specified for cement concrete flooring.

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18. CEMENT CONCRETE FLOORING WITH RED OXIDE TOPPING

18.1. GENERAL :

Red oxide of iron when used, gives an improved appearance to concrete flooring. The specifications shall be as under.

18.2. RED OXIDE OF IRON :

Red oxide powder as the name indicates is a fine powder of iron oxide, red in colour normally available in market shall be obtained in adequate quantity and stores in clean dry place.

18.3. PREPARATION OF BASE :

The specifications for cement concrete flooring (I.P.S.) shall be followed for this work also.

18.4. UNDER LAYERS :

The under layer of flooring of specified thickness shall be of cement concrete 1:2:4 mix using 10mm. maximum size coarse aggregate. The dividing strips of aluminium or glass if required to be retained shall not be removed and kept in position properly. After the consolidation is over, the top surface shall be left rough by drawing diagonal lines 2 mm. deep at 75 mm. centres both ways.

18.5. TOP LAYER :

18.5.1. Mortar: The top layer shall consist of uniform and smooth layer of specified thickness and of mix 1.3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement. The cement shall be mixed dry with red oxide powder in the proportion of 3.5 kg. of red oxide to 50kg. (1 bag) of cement. This mixture shall be used in both the cases i.e. for mixing mortar for top layer and also for floating coat. Full quantity of materials required for one room shall be mixed and kept ready to ensure uniform colour. Net mortar shall be prepared in usual manner.

18.5.2. Laying of Top Layer: The top plaster shall be done the following day after the under layer is laid. The plaster shall be done to specified thickness (normally 10 mm.) and finished smooth with cement and red oxide slurry at 2.2 kg. of cement red oxide mix per sqm. The surface shall be polished smooth with polishing stones.

Alternate panels shall then be taken in hand for laying under layers, top layers as process repeated. Rounding at the junction with the wall shall be done, if required, to a radius of 25 mm.

18.6. CURING: Similar to Cement concrete flooring (IPS)..

18.7. MODE OF MEASUREMENT: Similar to Cement concrete flooring (IPS).

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GENERAL NOTE FOR ALL TILING WORKS:

Where the size of flooring files and height of risers, skirting or dado does not admit full size of other finished size tiles, the tile(s) are to be cut / sawn to the required size and nothing extra shall be paid for the same. Sand should not be stacked adjacent to constructed walls, but away if in rooms while tiling. Full cement paste should be pasted to back of wall tiles prior to pressing against the wall. Tile should be laid on roughned wall plastered/concrete surface. Tile should be dipped in water prior to laying as per standard construction practices . Coloured readymade grout / White cement with coloured pigment shall be used of approved make for jointing location of colour matching the tiles ,sample for this activity shall be firstly conducted at one location got it approved from the EIC prior to proceding with the rest of the tiling work. Sample of the tiles shall be brought by the contractor got it approved from Architect/EIC prior to order.

19. TERRAZZO / CEMENT TILE FLOORING, SKIRTING/ DADO ETC.:

19.1. MORTARS :

19.1.1. Lime Mortar : Deleted

19.1.2. Cement Mortar : This shall be prepared by mixing cement and sand in specified proportions given in schedule of quantities, in a mixer. Hand mixing will not be allowed.

19.1.2.1. Proportioning : The unit of measurement for cement shall be a bag of cement weighing 50 kg. and this shall be taken as 0.035 cum.. Sand in specified proportion shall be measured in boxes of suitable size. It shall be measured on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage which shall be determined as per IS specifications and as per the method given herein before.

19.1.2.2. Mixing : The mixing of mortar shall be done at site of work in mechanical mixer. Hand mixing, if permitted, shall be done as directed by the Engineer-in-charge.

19.1.2.3. Mixing in Mechanical Mixer : Cement and sand in the specified proportion shall be mixed dry Care shall be taken not to add more water than that shall bring the mortar to the consistency of a stiff paste.

Only the quantity of mortar, which can be used within 30 minutes of its mixing shall be prepared at a time. Mixer shall be cleaned with water each time, before suspending the work.

19.1.2.4. Hand Mixing : The measured quantity of sand shall be levelled on clean masonry platform and cement bags emptied on top. In hand mixing the quantity of cement shall be increased by 5% above the specified, with no extra cost. The cement and sand shall be thoroughly mixed dry by being turned over and over backwards and forwards several time till the mix is of a uniform colour. The quantity of dry mix which shall be used within 30 minutes shall then be mixed in thoroughly with just sufficient quantity of water to bring the mortar to the consistency of a stiff paste. Mixing of mortar on floor slabs or

landings of staircase shall not be allowed.

19.1.3. General : Mortar shall be used as soon as possible after mixing and before it has begun to set, and in any case within 30 minutes after the water is added to the dry mixture. Mortar unused for more than 30 minutes shall be rejected and removed from the site of work.

19.2. MATERIALS :

The terrazzo/ cement tiles for flooring and skirting shall be hydraulically pressed under a minimum pressure of 140 kg./sqcm. and shall conform to I.S. 1237-1959 in respect of constituent materials, manufacture, shape, tolerances, wearing layers, colour, appearance, general quality of tiles, strength, resistance to wear, water absorption and other tests. The tile shall be nominal size and thickness as specified in the schedule for flooring, skirting, dado work etc. and shall be of approved make.

E.I.C or his representative shall be at liberty to inspect the manufacture of tiles even at the factory to ascertain whether the manufacture is as per the approved tiles for its quality of materials and manufacture. Tiles to be used for skirting and dado shall be semipolished before placing in position. Contractor shall submit samples for flooring and skirting tile for approval of the Engineer-in-charge. The Engineer-in-charge may direct new samples made with varying proportions, sizes and colour of terrazzo chips against varying base before conveying his decision about the approved samples. No claims will be entertained for rejected samples. The contractor shall ensure the terrazzo finish as per approved sample for the entire qty. of tiles, by dry mixing of the cement, marble chips, powder, white cement, pigments etc. in the same proportions. For wearing layer of all tiles, the contractor shall use the cement from one consignment only to ensure uniformity in background colour/ shade.

If there is a doubt about the quality of the tiles, they shall be tested from each consignment as specified in I.S. 1237-1959 and cost of testing shall be borne by the contractor. Sample tiles after being approved shall be kept with the Engineer-in-Charge for reference till the completion of the work. All tiles which are to be incorporated in the work shall strictly conform to the approved samples.

The tiles shall be stored in room or under such cover as will prevent exposure to dampness, sun, rain, accidental injury or staining. Tiles to be incorporated in the work shall be immersed in water for a minimum period of 6 hours before use.

19.3. BEDDING/ BACKING COAT :

In case of flooring / skirting, the mortar bedding / backing shall be of cement mortar of specified thickness and mix as specified in the schedule of work.. All the ingredients of cement mortar shall be got approved by the Engineer-incharge before incorporating in the work.

19.4. CLEANING OF SURFACE & LAYING OF CEMENT MORTAR BEDDING :

Before laying the cement mortar bedding the concrete floor surface shall be thoroughly hacked, cleaned of all mortar scales, concrete lumps etc. brushed, washed with water to remove mud, dirt etc. from the surface and shall be thoroughly

wetted. Until and unless the surface is approved by the Engineer-in-charge, the flooring shall not be started. A bedding of cement mortar (1:4 of specified thickness or more if required to make up the level or grade) shall be laid evenly and to the required slopes as directed. The terrazzo tiles shall then be laid immediately after laying the mortar. All tiles shall be truly and evenly set in a thick slurry of cement of honey like consistency applied to the sides and bottom and over the prepared base at the rate of 4.4 kg/sqm over such an area would accommodate about 20 tiles. The tiles shall then be tamped down with wooden mallet until they are properly bedded and exactly in true plane and line, with the adjacent tiles. Care shall be taken to ensure that the tiles are solidly bedded without voids and air pockets. All tiles shall be extended upto the unplastered surfaces of masonry walls/ RCC columns/ RCC walls. Wherever full tiles / half tiles can not be fixed, tiles shall be cut /sawn from full tile to the required size and their edges rubbed smooth to ensure a straight and true joint. The tiles shall be close jointed in matching cement slurry and the cement slurry oozing out through the thin joints shall be immediately wiped clean. The joints between the tiles shall not be greater than 1.5 mm. and shall be kept in straight lines or to suit the required pattern. The junction between wall plaster and tile work shall be finished neatly and without any waviness. All tiles shall be laid as to have continuous lines from various rooms to the passage. No change of lines shall be permitted at junction between rooms and passage. The joints shall be fine and made neatly indistinguishable by grouting of the joints @ 2.20 kg/sqm of grey cement slurry mixed with suitable colouring pigments to match with the tiles. People should not be allowed to walk over the freshly laid tiles.

Adjustment of levels in thickness of mortar bedding due to different type of flooring if any, shall be done by the contractor within a reasonable limit/distance as directed by the Engineer-in-Charge without any extra cost .

19.5. CURING, POLISHING & FINISHING:

The day after the tiles are laid, all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5mm. and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shade of the topping of the wearing layer of the tiles.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be ground evenly with machine fitted with coarse grade grit blocks (No. 60). Water shall be used profusely with grinding. After grinding, the surface shall be thoroughly washed, remove all grindings, mud cleaned and mopped, and the joints opened out during grinding shall be grouted once again wherever necessary with matching cement. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit blocks (No. 120) and shall be grouted again the opened out joints with matching cement.

The final grinding with machine fitted with the finest grade grit blocks (NO.320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor as ordered by the Engineer-in-charge.

For small areas or where circumstances so required, hand polishing may be permitted in lieu of machine polishing after laying, entirely at the discretion of the

Engineer-in-charge. For hand polishing, the following carborundum stone shall be used. The polishing shall be done in such a manner that there are no visible scratches on the terrazzo tiles. If scratches are observed, the tiles shall be removed and replaced by new tiles.

1st Grinding	Coarse Grade stone (No. 60)
2nd Grinding	Coarse Grade stone (No. 60)
Final Grinding	Fine grade stone (No. 120)

In all other respects, the process shall be similar as for machine polishing. After the final polish, oxalic acid crystals ground into powder shall be dusted over the surface (@ 2/3 1b per 100 sft. or 32.5 gm. per sqm.), sprinkled water and rubbed hard with Namdah" block (pad of woolen rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean. If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished.

The finished floor shall not sound hollow when tapped with a wooden mallet.

19.6. TERRAZZO / CEMENT TILE SKIRTING :

Terrazzo tile in skirting shall be of size as specified in schedule of quantities or as directed by the Engineer-incharge, hydraulically pressed and shall be obtained from the same source as for the terrazzo/ cement tiles for flooring. The design and shade of the skirting tiles shall be exactly similar to that of flooring tiles. The specifications for materials and workmanship shall be same as for flooring except that the skirting tile shall be laid against a 12 mm. thick backing of cement mortar 1:3 to the full height of skirting, thus allowing uniform projection beyond the plastered surfaces. In case of dado, the back of tiles shall be buttered with a coat of grey cement slurry/paste and edges with grey or white cement slurry/paste as the case may be, with or without pigment to match the shade of tiles and set in the backing/bedding mortar. Any cutting of brick work, concrete etc. required due to unevenness of brick surface shall be carried out at no extra cost to maintain this uniform projection beyond the plastered surfaces.

The skirting tiles shall be true in plane, line, level and plumb or in slope. The vertical lines of skirting tiles should be in line with that of flooring tile lines. The colour of the skirting tile and floor tile shall match. The undone portion of plaster work left above the terrazzo tile skirting work shall be finished round or as directed by the Engineer-incharge in the matching plaster. The item of plastering shall be inclusive of this plaster finishing above the skirting tiles, required to be done after laying of skirting tiles. No additional payment will be admissible for this extra operation.

19.7. SAMPLING AND TEST:

Tiles required for carrying out tests described below shall be taken by "random sampling". Each tile samples shall be marked to identify the consignment from which

it was selected. Minimum quantity of tiles for carrying out the test and frequency of test shall be as per IS : 13801. Cost of these tests shall be borne by the contractor.

Mandatory Tests	No. of Samples	Results
a) For conformity to requirements of	12 tiles	Concavity & Convexity shall not exceed 1 mm.
b) For wet transverse	6 tiles	Strength shall not be less than 30 kgf/cm^2
c) For resistance to wear test	6 tiles	Average wear shall not exceed 3.50 mm and wear on
d) For water absorption test	6 tiles	Shall not be more than 10%

19.8. MODE OF MEASUREMENT :

The length and / or width of the flooring / skirting / dado shall be measured net between the faces of skirting or dado or plaster faces of walls which is the proudest, and height of skirting / dado shall be measured from the finished level of floor. All openings exceeding 0.1 sqm. in area where tiling is not done shall be deducted and net areas only shall be measured and paid for. Flooring under dado, skirting or plaster shall not be measured for payment. Nothing extra shall be paid for use of cut tiles nor for laying the floor at different levels in the same room.

All dimensions shall be measured correct upto 2 places of decimal of a meter and area so worked out shall be correct upto two places of decimal of a sqm. for flooring, skirting, dado etc.

Note: Wastage in tile cutting to get the required dimension of rooms etc. as specified in drawing or as directed by the Engineer-in-charge shall have to be taken into consideration by contractor while quoting the rate for work to be measured as above. No extra claim on this account will be entertained.

19.9. PLAIN CEMENT TILE FLOORING & SKIRTING :

The specifications, mode of measurements etc. in respect of terrazzo tiles in flooring and skirting shall be applicable in general to plain cement tiles except that no marble chips & white cement shall be used in tile manufacture.

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20. IN-SITU TERRAZZO FLOORS, SKIRTING, TREADS OF STAIRCASE, WINDOW SILLS ETC.

20.1. FLOORING :

In situ terrazzo flooring, the underlayer shall consists of cement concrete mix 1:2:4 (the maximum size of aggregate used shall not exceed 10 mm.) the thickness of which shall be as specified in item of schedule of quantities.

The terrazzo topping shall consist of white cement or grey cement wherever specified in the schedule of quantity with or without pigment and marble chips of best approved quality, shade and grade all mixed in proper proportion as provided in I.S. 2114 and/ or approved by the Engineer-in-charge. The total combined thickness of the underlayer and topping shall as provided in the I.S. Specification and as specified and approved by the Engineer-in-Charge.

The floor surface shall be thoroughly cleaned of all dirt, dust, laitance and loose material, thoroughly wet with water and then smeared with cement slurry. Cement concrete under layer immediately be laid in regular bays not exceeding 1.5 sqm. in area or as directed and allowed to harden. The surface of screed shall be well scratched whilst it is not sufficiently hard to form key for terrazzo topping. 25 x 1 .5 mm. aluminium dividing strips or 3mm. thick glass dividing strips whichever specified in the item of schedule of quantities shall be placed to form bays as directed. When the screed has sufficiently hardened but not later than 24 hours, it shall be thoroughly cleaned down, washed with water and brushed over with neat cement slurry of about the consistency of thick cream. Terrazzo top layer shall then be laid in alternative bays in plastic condition, well troweled into position. Surplus moisture and cement slurry from surface shall be removed and allowed to set sufficiently hard to stand machine or hand grinding, thoroughly cleaned to reveal surface voids, and grouted with neat cement of the same tint as used in terrazzo. When dry and hard, machine grinding with grit blocks as per specifications for terrazzo tiles shall be done with 3 to 5 days between successive grinding during which the terrazzo shall be cured and grouted with neat cement of same tint, if required. The entire surface shall then be kept wet for at least seven days. The edges of treads and window sills shall have straight edges and corners properly rounded up. In case of window sills, only top layers is covered under the relevant item and concrete base layer under RCC item. The window sills and treads of staircase shall be hand polished instead of machine polished.

Cleaning and applying oxalic acid shall be same as specified for terrazzo tile flooring.

20.2. IN-SITU SKIRTING & DADO ETC. :

In situ skirting and dado shall be as specified in the schedule of finishes.

The surface shall be prepared as per plastering work where required by the architects, the dado or skirting shall be sectionalised as for in situ floor. If shown and required, the junction of the floor and dado shall be rounded to a proper, neat and uniform round to the satisfaction of the Engineer-in-charge. After the work is complete, the surface shall be kept continuously wet for 7 days. Unless otherwise specified, skirting and dado shall match the floor.

Terrazzo skirting and dado shall consist of under coat of 1:4 cement- sand plaster of the thickness specified. This shall be laid simultaneously with the borders of the flooring and same joints as in the floor shall continue. The topping shall be terrazzo as per specifications for in-situ terrazzo flooring except that in-situ polishing shall be done by hand to the satisfaction of Engineer-in-charge. 1 .5 mm. thick aluminium strip joint (wherever mentioned 3mm. glass strips shall be fixed) shall be provided in situ terrazzo in both direction or as directed. Care shall be taken to see that the terrazzo in skirting and dado matches the floors. The dado work in columns shall be done in one operation for the full height of the column. The shape of the finished surface shall be uniform for all such columns treated and checked for its accuracy during the progress of work.

20.3. MODE OF MEASUREMENT :

Mode of measurement for cast-in-situ terrazzo flooring and dado shall be same as per terrazzo tile flooring and skirting.

The rate shall include all materials, curing, rounding of junctions, labour, scaffoldings etc..

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21 KOTAH STONE FLOORING/ SKIRTING/ FACIA / SHELVES :

MATERIALS : . The stone shall be hard, sound, durable, homogeneous in texture and resistant to wear. These shall be without any soft veins, cracks or flaws and shall have uniform colour. They shall have natural surface free from broken flakes on top. Hand cut/ machine cut for exposed edges and machine polished. Kotah stone shall be of the best quality and of the specified thickness, size and the shade, which shall be got approved by the Engineer-in-charge. The contractor shall get it one time polished at vendor shop and only the similar colour & texture Kota stones shall be sorted and delivered at site.

The slabs / tiles shall be rectangular or square in shape or as per pattern shown in drawing and as directed by the Engineer-in-charge. The sizes given in schedule of quantities are tentative and can vary only slightly as per the availability in the market. The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the item. Tolerance of (+/-) 2 mm shall be allowed for the thickness. In respect of length & width, tolerance in length & width shall be permissible upto (+/-) 5 mm for hand cut slabs & (+/-) 2 mm for machine cut slabs. At its thinnest, no stone shall be thinner than the specified thickness.

Uniformity of size and colour / shade shall generally be maintained for the stones used in any one room. The exposed surface shall be machine polished to a smooth, even and true plane and the edges hand cut and dressed true and squares. The evenness of the surface of slabs and edges of the slab shall not be marred by careless dressing or handling and no patching up shall be allowed for the slab. The edges shall be quite straight. The under face may be left as required or rough dressed. Before taking up the work, samples of stone slabs to be used and their dressing and polishing shall be got approved by the Engineer-in-charge and kept in his office as approved sample and the stone slabs to be used shall conform to the same.

BEDDING/ BACKING COAT : In case of flooring / skirting / dado, the mortar bedding / backing shall be of cement mortar of thickness and mix specified in the schedule of work.

CEMENT MORTAR: Cement mortar bedding shall be as specified under relevant specification for terrazzo / plain cement tile flooring.

CONSTRUCTION DETAILS: Cement mortar as specified for bedding shall be uniformly mixed. 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, set mortar scum or laitance and of loose materials by hacking and brought to original levels and then well wetted without forming pool of water on surfaces.

FIXING THE STONE SLAB/ TILE : Before laying, the stone shall be thoroughly wetted with clean water, neat cement grout (2.75 kg/ sqm.) of honey like consistency shall be spread on the mortar bed over as much areas as could be covered with the slabs within half an hour. The specified type of stone 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 shall be gently tapped with wooden mallet till it is firmly and properly bedded.

There shall be no hollows left. If there is a hollow sound on gently tapping off the slab, such slab shall be removed and reset properly. The joints shall be grouted with matching cement slurry. Approved pigment shall be used in cement slurry to match with shade of stone. Pigment required to match the shade of stone shall be supplied by the contractor at no extra cost. The stone adjoining the wall shall go about 12mm. under the plaster, skirting or dado for the wall. All stone slabs, tiles shall be so laid as to have continuous lines from various rooms to the corridors. No change of lines shall be permitted at junction between rooms and corridors. Only one piece machine cut, Kotah stone shall be used for treads and risers, unless otherwise specified in the tender schedule..

CURING : The work shall be kept well wetted with damp sand or water for seven days.

POLISHING AND CLEANING : When the bedding and joints have completely set and attained required strength, the surface shall be machine polished to give smooth, even and true plane to the flooring. All flooring shall be thoroughly cleaned and handed over free from any mortar stains etc. Polishing shall be done as per relevant IS and IS-14223 (Specification for polished building stones).

SKIRTING AND DADO/ FACIA : The quality and type of stone shall be same as mentioned for flooring except of their height and thickness or backing coat which shall be as mentioned in item schedule. The backing shall conform to the specifications for cement mortar specified for item of terrazzo tiles. Contractor should take into consideration the fact that touching up of the plaster at the junction of skirting / dado is invariably done after the skirting/ dado/ facia work is completed and quote rates accordingly. Nothing extra for the same shall be entertained.

Fixing, curing, polishing and cleaning shall be as specified herein before under cement/ terrazzo tile skirting. Polishing may be done by hand, but a smooth surface and fine polishing shall be obtained. Joints shall be finished in neat matching cement slurry. The junction of plaster and the upper edges of the dado/ skirting shall be finished smoothly as directed by the Engineer-in-charge without any extra cost.

MODE OF MEASUREMENTS : Flooring, skirting and dado/ facia shall be measured same as that for terrazzo cement tile, flooring/ skirting/ dado. Unless otherwise specified, shelves shall be paid on area basis in sqm. calculated to two places of decimal, where length and breadth shall be measured inclusive of bearings correct to a cm. The permissible tolerance in the specified thickness shall be (+/-) 2 mm.

Note : Wastage in obtaining the required machine cut, hand cut sizes as specified from the commercial sizes available in market shall be taken into consideration by contractor while quoting the rate for work and no extra claim on this account shall be entertained.

TANDUR STONE / CUDDAPPA STONE / POLISHED SHAHABAD STONE / BLUE WADI STONE FLOORING / SKIRTING / DADO:

The specifications for these items shall be similar to those for Kotah stone as above.

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22. GLAZED TILE FLOORING, DADO/ SKIRTING/ FACIA.

22.1. MATERIALS :

White Glazed Tiles : The tiles shall be of approved make and shall generally conform to IS :13712. They shall be flat and true to shape and free from cracks, blisters, welts, crawling, crazing spots, chipped edges, corners or other imperfections detracting from their appearance. The glazing shall be of uniform shade.

The wall tiles shall be of square or rectangular of nominal sizes such as 450x300 mm, 300x200mm, 150x150mm, 100x100mm, 100x200mm or other as directed by the EIC. The length of all four sides shall be measured correct to 0.1 mm and average length-breadth shall not vary more than (+ / -) 0.8 mm from specified dimensions. The variation of individual dimensions from average value of length/breadth shall not exceed (+ / -) 0.5 mm. Tolerance in thickness shall be (+ / -) 0.4 mm. Size of tiles different form the specified one, may be allowed to be used with prior approval of the EIC.

The thickness of the tiles shall not be less than 5 mm or as specified in the items and shall confirm to I.S. 13712 in all respects. Samples of tiles shall be got approved by the Engineer-in-charge before use on the work. Top surface of tile shall be glossy or matt as specified. The underside of tiles shall not have glaze on more than 5% of the area in order to have proper adherence to the back.

22.2. PREPARATION OF SURFACE & LAYING :

Sub grade concrete or RCC slab or side brick wall/ or plastered surfaces on which tiles are to be laid shall be cleaned, wetted and mopped as specified for tile flooring.

The bedding/backing for the tile shall be of C.M. 1.3 or as specified and shall be applied and allowed to harden. The mortar shall be roughened with wire brushes or by scratching diagonal lines 1.5mm. deep at 7.5mm. centre both ways.

The back of tiles shall be buttered with a coat of grey cement slurry paste and edges with white cement slurry/coloured ready grout of approved make and set in the bedding mortar. The tiles shall be tapped gently with wooden mallet and corrected to proper planes and lines. The tile shall be butt jointed in pattern and joints shall be as fine as possible. The top of skirting/ dado shall be truly horizontal and joints truly vertical.

After a period of curing of 7 days minimum, the tiles shall be cleaned and shall not sound hollow when tapped.

The surface during laying shall be checked with a straight edge 2 m. long. Where full size tiles cannot be fixed, these shall be cut/sawn to the required size & their edges rubbed smooth to ensure straight and true joints.

Tiles shall enter not less than 10mm. under side skirting.

After the tiles have been laid, surplus cement grout shall be cleaned off.

22.3. MORTAR AND BEDDING :

Cement mortar for bedding shall be of proportion specified in items schedule and shall conform to the specification for materials, preparations etc. as specified under cement mortar. The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in preparation of the mortar to ensure that there are no hard lumps that would interfere withe 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 well wetted without forming any pools of water on the surface. The mortar of specified proportion and thickness shall then be even and smoothly spread over the base by use of screed battens to proper level or slope.

Cement mortar of thickness and proportion as specified in the schedule for dado shall be applied to the wall after preparing the wall surface as specified under cement plaster 20mm. thick and brought to correct line and plumb and the surface left rough to receive the tiles.

22.4. FIXING OF TILES FOR FLOORING :

The tiles before laying shall be soaked in water for atleast 2 hours. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles. Tiles which are fixed on the flooring adjoining the wall shall be so arranged that the surface on the round edge tiles shall correspond to the skirting or dado. Neat cement mortar grout 1:2, using fine sand (table III, zone-IV and as per I.S. 383) of honey like consistency shall be spread over the bedding mortar just to cover as much area 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 line. The surface of the flooring during laying shall be frequently checked with a straight edge about 2M long to obtain a true surface with the required slope. The joints between tiles shall not exceed 1.00 mm. in width. The joint shall be grouted with white/matching colour cement slurry. After fixing the tiles, finally in an even plane or slope, the flooring shall be covered with wet sand and allowed undisturbed for 14 days.

22.5. FIXING TILES FOR DADO & SKIRTING/FACIA :

The dado work, shall be done only after fixing the tiles/slabs on the floor. The approved white glazed tiles before laying shall be soaked in water for atleast 2 hours. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff.

The back of the tile shall be covered with this layer of cement mortar 1:2 using fine sand (table III, zone IV, I.S. 383-1963) and the edge of the tile smeared with neat white cement slurry. 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 bottom of wall upwards without any hollows in the bed of joints. Each tile shall be as close as possible to one adjoining. The tiles shall be jointed with white cement slurry. Any thickness difference in the thickness of the tiles shall be arranged out in cushioning

mortar so that all tiles faces are in one vertical plane. The joints between the tile shall not exceed 1.00 mm. in width and they shall be uniform.

While fixing tiles in dado work, care shall be taken to break the joints vertically. The top of the dado shall be touched up neatly with the rest of the plaster above.

After fixing the dado/skirting etc. they shall be kept continuously wet for 7 days.

If doors, windows or other openings are located within the dado area, the corners, sills, jambs etc. shall be provided with true right angles without any specials. The contractor will not be entitled to any extra claims on this account for cutting of tiles if required.

22.6. CLEANING :

After the tiles have been laid in a room or the days fixing work is completed, 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 over shall be washed thoroughly clean. In the case of flooring, 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. It shall be removed only after completion of the construction work and just before the floor is used.

22.7. POINTING AND FINISHING :

The joints shall be cleaned off with wire brush to a depth of 3 mm. and all dust and loose mortar removed. Joints shall then be flush pointed with white cement and floor kept wet for 7 days and then cleaned. Finished floor shall not sound hollow when tapped with a wooden mallet.

22.8. MODE OF MEASUREMENT :

Dado/flooring/skirting shall be measured in sqm. correct to two places of decimal. Length and breadth shall be measured correct to 1 cm. between the exposed surfaces of skirting or dado. No deductions shall be made nor extra paid for any opening of area upto 0.1 sqm.

The rate shall include all the cost of labour and materials involved.

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23 CHEQUERED TILES IN STAIR TR EADS AND LANDINGS:

a. SCOPE OF WORK :

The work envisaged under these specifications consists of supplying and laying chequered cement tiles in the treads of staircase steps and over landings.

b. MATERIALS :

Chequered Tiles: The size of tiles including nosing shall be as shown in drawing and shall have the thickness not less than 28 mm.

The nosing edge of the tile shall be rounded and the front portion of the tiles for a minimum length of 75 mm. from and including the nosing shall have groves running parallel to the nosing and at centres not exceeding 25 mm. Beyond that the nosing tiles shall have normal chequered pattern, centre to centre distance being not less than 25 mm. and not more than 50 mm. The nosing shall have the same wearing layers as the top portion of the tile.

The overall thickness of the tile as mentioned earlier shall not be less than 28 mm. with the top layer measured from the top of the chequers which shall not be less than 6 mm. The tiles shall be given the first grinding before delivery to site. The tiles shall conform to the specification for terrazzo tiles/cement tiles, in respect of method of manufacture and the mix of the backing and wearing layers, as specified in the item.

c. PREPARATION OF SURFACE AND LAYING :

The method of preparation of surface and laying shall generally be similar to as specified herein before under terrazzo tile flooring.

d. CURING, POLISHING AND FINISHING :

The specifications shall be the same as specified herein before under terrazzo tile flooring except that polishing of the treads nosing and chequered grooves, after laying shall be done by hand. Special care shall be taken to polish the nosing and the grooves in such a manner as to get a uniform erection for the grooves and the nosing and their finish shall match with the finish of the flat portion of the tiles.

e. MODE OF THE MEASUREMENT :

Length shall be measured from finished face of skirting, dado or wall plaster correct to a centimetre and the width shall be measured from the outer edge of the tread to the finished face of riser. In the case of tiles laid over the landing, the mode of measurement shall be as per terrazzo tiles specifications. The area shall be in square metres correct to two places of a decimal.

The rate shall include the cost of all materials and labour, transport, scaffolding etc. required in all the operations described above.

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24 MARBLE STONE FLOORING, TREADS, RISERS, SILLS, CLADDING, DADO ETC. :

a. MARBLE STONE SLABS :

The colour and quality of marble slabs shall be of the kind of marble specified in item/drawings/as directed by the Engineer-in-charge. The marble from which the slabs are made, shall be of selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. Before starting the work, the contractor shall get the samples of marble slabs approved by the Engineer-in-charge. All slabs which goes into work shall strictly conform to the samples, failing which the entire materials are likely to be rejected.

The slabs shall be machine polished and machine cut to the dimensions specified in items of schedules of quantities/drawings and as directed by the Engineer-in-charge.

b. DRESSING OF SLABS :

Every stone shall be cut to the required size and shape, fine dressed on all sides to the full depth so that a straight edge laid along the side of the stone is full in contact with it. The top surface shall also be fine dressed to remove all waviness. The top surface of slabs shall be machine polished and exposed edges machine cut, or as specified in the item and as directed by the Engineer-in-charge. All visible angles and edges of the slabs shall be true, square or as required, and free from chippings and the surface shall be true and plane.

The thickness of the slabs shall be 25 mm. or as specified in the description of item. The minimum size of stone to be used for various items shall be as mentioned in the schedule of quantities/drawings of this tender. Marble stones of approved smaller sizes other than mentioned in the schedule of quantities, if required for bands, borders, flooring etc. shall be provided and laid as directed by the Engineer-in-charge.

Any opening of required size and shape at any desired place in flooring, bands, borders etc. shall be made in such a way that marble bounded by number of marble stones/slabs. No broken or defaced stone shall be permitted in the work.

c. BEDDING/BACKING MORTAR :

The bedding/backing shall be of cement mortar/lime mortar of mix and thickness as specified in the description of the item.

i. **Mixing :** The mixing of mortar shall be done in mechanical mixer or hand mixing as specified/as directed by the Engineer-in-Charge.

a) **Mixing in Mechanical Mixer :** Cement and sand in the specified proportion shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste.

Only the quantity of mortar, which can be used within 30 minutes of its mixing shall be prepared at a time.

Mixer shall be cleaned with water each time, before suspending the work.

b) **Hand Mixing :** If approved by Engineer-in-Charge, hand mixing shall be allowed. The measured quantity of sand shall be levelled on clean masonry platform and cement bags emptied on top. In hand mixing, the quantity of cement shall be increased by 5% over the approved constant, with no extra cost. The cement and sand shall be thoroughly mixed dry by being turned over and over, backwards and forwards, several times till the mixture gives an uniform colour. The quantity or dry mix which can be used within 30 minutes

shall then be mixed on masonry through with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

c) **General :** Mortar shall be used as soon as possible after mixing and before it has begun to set, and in any case within 30 minutes after the water is added to the dry mixture. Mortar unused for more than 30 minutes shall be rejected and removed from the site of work immediately.

d. LAYING - FLOORING :

Before laying the cement mortar bedding/backing, the concrete/brick, floor/wall surfaces shall be thoroughly hacked, cleaned of all mortar scales, concrete lumps etc., brushed, washed with water to remove mud, dirt etc. from the surface and shall be thoroughly wetted. Until and unless the surface is approved by the Engineer-in-Charge, the flooring shall not be started. A bedding of cement mortar of 20 mm. average thickness with the minimum thickness at any place under the slab not less than 13mm. shall be laid evenly and to the required slopes as directed. The marble slabs shall be thoroughly washed and cleaned and then be laid on the bedding/ backing with cement floating at the rate of 4.39 kg./sqm. All slabs shall be truly and evenly set in a thick cement slurry or paste like consistency applied to the sides and bottom and over the prepared base. The slabs shall then be tamped down with a wooden mallet until they are exactly in true plane and line with adjacent slabs. All slabs shall be extended upto the unplastered surface of masonry walls/RCC columns/RCC walls. The slabs shall be close jointed in matching cement slurry and the cement slurry coming out through the thin joints shall be immediately wiped clean. The grains of marble stone shall be matched as shown in drawing or as directed by the Engineer-in-Charge. All slabs shall be so laid as to have continuous lines from various rooms to the corridors. No change of lines shall be permitted at junction between rooms and corridor, if the same flooring is specified in both the places.

e. MARBLE SILLS, TREADS ETC. :

Marble stone for sills shall be of approved quality. Dressing of stone slab, mortar mix. for bedding/backing, laying etc. shall be similar to as described above as far as applicable. Marble slabs of specified thickness and width shall only be provided. The length of the each slab required for the sill shall be of the pattern which shall coincide with the lines of the mullions of windows where it is laid or as directed by the Engineer-in-Charge. Normally it shall not be less than 1.0 m. length.

f. 24.6 MARBLE STONE DADO & CLADDING :

Only machine cut and machine polished marble stone will be used. Brass cramps and brass pins of approved quality, size and make shall be provided. The brass pins shall be provided at the meeting of two marble slabs both ways horizontally and vertically. The brass cramps shall be provided at the places approved by the Engineer-in-Charge. Marble to be used shall be of approved size, colour, type of veins and laid as specified in schedule of quantities or to the pattern shown in drawings or as directed by the Engineer-in-Charge. Laying of marble stone shall be similar as stated above as far as applicable.

g. POLISHING AND FINISHING :

The polishing and finishing shall be carried out in the similar manner as specified under chapter "TERRAZZO / CEMENT TILES FLOORING, SKIRTING / DADO ETC." as far as it is applicable.

h. MEASUREMENT :

Marble stone flooring, sills, treads, risers, dado cladding etc. shall be measured in square metre correct to two places of decimal. The length and breadth shall be measured between the finished faces correct to two places of decimal of metre. No deduction shall be made nor extra paid for any opening of area upto 0.05 sqm. Nothing extra shall be paid for working at different levels.

NOTE : Wastage in marble slab cutting to get the required dimensions, as specified in drawing or as directed by the Engineer-in-Charge shall be deemed to be considered by the contractor while quoting the rate for work. The work shall be measured as above and no extra claim will be entertained on this account.

i. RATE :

The rate shall include the cost of all materials, transport tools, plants, scaffolding and labour involved in all operations described above.

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25 CERAMIC TILE FLOORING, DADO / SKIRTING / FACIA.

a. MATERIALS :

Ceramic Tiles : The tiles shall be of approved make and shall generally conform to IS : 13712-2006. They shall be flat and true to shape and free from cracks, blisters, welts, crawling, crazing spots, chipped edges, corners or other imperfections detracting from their appearance. The glazing shall be of uniform shade.

The tiles shall be of square or rectangular of nominal sizes as mentioned in schedule of quantities and as directed by the EIC. The length of all four sides shall be measured correct to 0.1 mm and average length-breadth shall not vary more than (+ / -) 0.8 mm from specified dimensions. The variation of individual dimensions from average value of length/breadth shall not exeed (+ / -) 0.5 mm. Tolerance in thickness shall be (+ / -) 0.4 mm. Size of tiles different form the specified one, may be allowed to be used with prior approval of the EIC.

The thickness of the tiles shall not be less than 6 mm or as specified in the items and shall confirm to I.S. 13712 in all respects. Samples of tiles shall be got approved by the Engineer-in-charge before use on the work. Top surface of tile shall be glossy or matt as specified. The underside of tiles shall not have glaze on more than 5% of the area in order to have proper adherence to the back.

b. PREPARATION OF SURFACE & LAYING :

Sub grade concrete or RCC slab or side brick wall/ or plastered surfaces on which tiles are to be laid shall be cleaned, wetted and mopped as specified for terrazzo tile flooring.

The bedding/backing for the tile shall be of C.M. 1.3 or as specified and shall be applied and allowed to harden. The mortar shall be roughened with wire brushes or by scratching diagonal lines 1.5mm. deep at 7.5mm. centre both ways.

The back of tiles shall be buttered with a coat of grey cement slurry paste and edges with cement slurry and set in the bedding mortar. The tiles shall be tapped gently with wooden mallet and corrected to proper planes and lines. The tile shall be butt jointed in pattern and joints shall be as fine as possible. The top of skirting/ dado shall be truly horizontal and joints truly vertical.

After a period of curing of 7 days minimum, the tiles shall be cleaned and shall not sound hollow when tapped.

The surface during laying shall be checked with a straight edge 2 m. long. Where full size tiles cannot be fixed, these shall be cut/sawn to the required size & their edges rubbed smooth to ensure straight and true joints.

Tiles shall enter not less than 10mm. under side skirting.

After the tiles have been laid, surplus cement grout shall be cleaned off.

c. MORTAR AND BEDDING :

Cement mortar for bedding shall be of proportion specified in items schedule and shall conform to the specification for materials, preparations etc. as specified under cement mortar. The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in preparation of the mortar to ensure that there are no hard lumps that would interfere withe 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 well wetted without forming any pools of water on the surface. The mortar of specified proportion and thickness shall then be even & smoothly spread over the base by use of screed battens to proper level or slope.

Cement mortar of thickness and proportion as specified in the schedule for dado shall be applied to the wall after preparing the wall surface as specified under cement plaster as specified in schedule of quantities and brought to correct line and plumb and the surface left rough to receive the tiles.

d. FIXING OF TILES FOR FLOORING :

The tiles before laying shall be soaked in water for atleast 2 hours. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles. Tiles which are fixed on the flooring adjoining the wall shall be so arranged that the surface on the round edge tiles shall correspond to the skirting or dado. Neat cement mortar grout 1:2, using fine sand (table III, zone-IV and as per I.S. 383) of honey like consistency shall be spread over the bedding mortar just to cover as much area as can be tiled within half an hour. The edges of the tiles shall be smeared with neat 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 line. The surface of the flooring during laying shall be frequently checked with a straight edge about 2M long to obtain a true surface with the required slope. The joints between tiles shall not exceed 1.00 mm. in width. The joint shall be grouted with /matching colour cement slurry. After fixing the tiles, finally in an even plane or slope, the flooring shall be covered with wet sand and allowed undisturbed for 14 days.

e. FIXING TILES FOR DADO & SKIRTING/FACIA :

The dado work, shall be done only after fixing the tiles/slabs on the floor. The approved ceramic tiles before laying shall be soaked in water for atleast 2 hours. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff.

The back of the tile shall be covered with this layer of cement mortar 1:2 using fine sand (table III, zone IV, I.S. 383-1963) and the edge of the tile smeared with neat cement slurry. 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 bottom of wall upwards without any hollows in the bed of joints. Each tile shall be as close as possible to one adjoining. The tiles shall be jointed with cement slurry. Any thickness difference in the thickness of the tiles shall be arranged out in cushioning mortar so that all

tiles faces are in one vertical plane. The joints between the tile shall not exceed 1.00 mm. in width and they shall be uniform.

While fixing tiles in dado work, care shall be taken to break the joints vertically. The top of the dado shall be touched up neatly with the rest of the plaster above.

After fixing the dado/skirting etc. they shall be kept continuously wet for 7 days.

If doors, windows or other openings are located within the dado area, the corners, sills, jambs etc. shall be provided with true right angles without any specials. The contractor will not be entitled to any extra claims on this account for cutting of tiles if required.

f. CLEANING :

After the tiles have been laid in a room or the days fixing work is completed, 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 over shall be washed thoroughly clean. In the case of flooring, 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. It shall be removed only after completion of the construction work and just before the floor is used.

g. POINTING AND FINISHING :

The joints shall be cleaned off with wire brush to a depth of 3 mm. and all dust and loose mortar removed. Joints shall then be flush pointed with cement and floor kept wet for 7 days and then cleaned. Finished floor shall not sound hollow when tapped with a wooden mallet.

h. MODE OF MEASUREMENT :

Dado/flooring/skirting shall be measured in sqm. correct to two places of decimal. Length and breadth shall be measured correct to 1 cm. between the exposed surfaces of skirting or dado. No deductions shall be made nor extra paid for any opening of area upto 0.1 sqm.

The rate shall include all the cost of labour and materials involved.

* * *

26 VITRIFIED TILE FLOORING, DADO / SKIRTING / FACIA :

a. MATERIALS :

Vitrified Tiles: The tiles shall be of approved make like Fully Vitrified / Marbonite / Granamite or equivalent and shall generally conform to the approved standards. They shall be flat and true to shape, free from cracks, crazing spots, chipped edges and corners. Unless otherwise specified, the nominal sizes of tiles shall be as under:

The Floor tiles shall be square or rectangular of nominal sizes such as: 600 x 600 mm; 900 x 900 mm, 300x300mm or as per tender schedule / drawings or as directed by the Engineer-in-Charge. Thickness shall be as per recommendations of

the approved manufacturers. Anti Skid tiles shall be for Toilet areas or as per Architectural drawings

Technical specifications of the tiles shall be generally conforming to the following standards:

TECHNICAL SPECIFICATIONS FOR VITRIFIED TILES

NO	PROPERTY	EXPECTED
1	Deviation in length	(+/-) 0.6%
2	Straightness of sides	(+/-) 0.5%
3	Rectangularity	(+/-) 0.6%
4	Surface flatness	(+/-) 0.5%
5	Water absorption	< 0.50%
6	Mohs. hardness	> 6
7	Flexural strength	> 27 N / mm²
8	Abrasion resistance	< 204 mm²
9	Skid resistance (friction	> 0.4
10	Glossiness	Min. 85% reflection

The tiles shall conform to the relevant standards in all respects. Samples of tiles shall be got approved from the Engineer-in-charge before bulk procurement for incorporation in the work.

b. **PREPARATION OF SURFACE FOR FLOORING:** Following procedure shall be followed:

- **Sub grade** concrete or RCC slab or side brick wall / or plastered surfaces on which tiles are to be laid shall be cleaned, wetted and mopped as specified for terrazzo tile flooring.

- **Mortar and bedding:** Cement mortar for bedding shall be prepared of mix 1:4 or as specified in the schedule of items, to a consistent paste and shall conform to the specification for materials, preparations etc. as specified under cement mortar. The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in preparation of the 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 off all dirt, scum or laitance and loose materials and well wetted without forming any pools of water on the surface. The mortar of specified proportion and thickness shall then be evenly and smoothly spread over the base by use of screed battens to proper level or slope.

- Once the mix is prepared, no further water be added and the same shall be used within one hour of adding water. Apply on an average 20 mm thick bedding of mortar over an area of 1 sqm. at a time over surface of the area for laying tiles, in proper level and allowed to harden sufficiently to offer a fairly good cushion for the tiles to set..

c. **LAYING OF TILES FOR FLOORING :** The tiling work shall be done as per the pattern shown in the drawing or as directed by the Engineer-in-Charge. As a general practice laying of tiles shall be commenced from the centre of the area and advanced towards the walls. Cut tiles, if any, shall be laid along wall with necessary border pattern as shown / directed by the Engineer-in-Charge. Tiling work shall be completed by pressing tiles firmly into place along the wall / floor. A white cement slurry to the back of the tile to be applied to ensure proper and full bedding. The tiles shall be laid on the bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles. Tiles, which are fixed on the flooring adjoining the wall, shall be so arranged that the surface on the round edge tiles shall correspond to the skirting or dado. Press gently the tile with wooden mallet for even adherence at the back of the tile. Do not use an iron hammer or some heavy material to press the tile.

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 line. Unless otherwise specified, joint-less tiling shall be done butting the tiles with each other. If joint is specified, the same shall not exceed 1.00 mm. in width. The joint shall be grouted with white / matching colour cement slurry. After fixing the tiles, finally in an even plane or slope, the flooring shall be covered with wet sand and allowed undisturbed for 14 days.

d. **FIXING TILES FOR DADO & SKIRTING / FACIA : :** The fixing of tiles on wall surfaces shall be done only after completing fixing of the tiles on the floor. Following procedure shall be followed:

- The back of tiles shall be cleaned off and covered with layer of approved adhesive like BAL-ENDURA or equivalent with proper trowelling as per manufacturers recommendations.

- The edges of the tiles shall be smeared with the adhesive and fixed on the wall one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly fixed in level with the adjoining tiles. There shall be no hollows on the back or in joints. Unless otherwise specified, joint-less tiling shall be done butting the tiles with each other. If joint is specified, the same shall not exceed 1.00 mm. in width. The joint shall be grouted with approved adhesive. The joints shall be kept in straight line or as per the approved pattern.

- While fixing tiles in dado / skirting work, care shall be taken to break the joints vertically. The top line shall be touched up neatly with the rest of the plaster above. If doors, windows or other openings are located within the dado area, the corners, sills, jambs etc. shall be provided with true right angles without any specials. The contractor will not be entitled to any extra claims on this account for cutting of tiles if required.

- The fixing shall be done from bottom of wall to upward without any hollows in the bed of joints. Each tile shall be as close as possible to one adjoining. All tiles faces shall be in one vertical plane.

e. **GROUTING OF JOINTS IN FLOOR / SKIRTING / DADO:** The joints, if specified, shall

be cleaned off and all dust and loose particles removed. Joints shall then be filled with approved adhesive like BAL-ENDURA or equivalent grouts. After finishing the grouting process, after 15 minute, wipe off excess grout with a damp sponge and polish the tiles with a soft & dry cloth for a clean surface. The Finished work shall not sound hollow when tapped with a wooden mallet.

f. **CLEANING :** As directed by the Engineer-in-Charge, the tiles shall be cleaned by mild acid (However, Hydrofluoric acid and its derivatives should not be used). After the tiles have been laid in a room or the days fixing work is completed, the surplus cement grout / adhesive that may have come out of the joints shall be cleaned off before it sets. The dado / skirting shall be thoroughly cleaned. In the case of flooring, once the floor has set, the floor shall be carefully washed clean and dried. When drying, the floor shall be covered with oil free dry sawdust. It shall be removed only after completion of the construction work and just before the floor is used.

g. **MODE OF MEASUREMENT AND RATE:** Dado / flooring / skirting shall be measured in sqm correct to two places of decimal. Length and breadth shall be measured correct to 1 cm. between the exposed surfaces of skirting or dado. No deductions shall be made nor extra paid for any opening of area upto 0.1 sqm. The rate shall include all the cost of labour and materials involved.

h. **CLEANING AGENTS FOR VITRIFIED TILES::** Vitrified tiles are resistant to all chemicals (except hydrofluoric acid and its derivatives), hence commercially available detergents and cleaning agents can also be used for regular maintenance. Any spills and stains must be removed immediately. If left dry they may leave stains, which may be difficult to remove completely.

CLEANING AGENTS FOR VITRIFIED TILES

STAINS	**CLEANING AGENT**
Robin Blue	Household detergent / Warm water
Marker ink	Turpentine / Acetone / Trichloroethylene
Pen ink	Acetone / Isopropyl alcohol
Methylene blue	Isopropyl alcohol / Acetone
Sauce	Ammonia solution
Cement	Turpentine / Acetone / Trichloroethylene /
Tea	Hydrochloric acid / Bleaching powder
Coffee	Sodium hydroxide / Potassium hydroxide
Beer	Sodium hydroxide / Potassium hydroxide
Diesel	Acetone / Petrol
Lab indicator	Acetone / Isopropyl alcohol
Cement and grouting	Hydrochloric acid
Pencil mark	Benzene or Toluene or Xylene
Plaster of Paris (POP)	Ammonium sulphate solution
Iodine (Tincture iodine)	Sodium hydroxide / Potassium hydroxide
Hair dye	Per chloric acid
Paan	Lemon juice or citric acid
Marker pen	Acetone

OT (other tiles). 9 TANDUR STONE/CUDDAPPA STONE/POLISHED SHAHABAD STONE / BLUE WADI STONE FLOORING / SKIRTING / DADO : The specifications

for Tandur, Cudappa, polished Shahabad and blue Wadi stone flooring / skirting / dado shall be similar to those respecting specifications for Kotah stone flooring / skirting / dado specified herein before in all respects.

* * *

27 RED OR WHITE ROUGH DRESSED SAND STONE FLOORING

a. Stone *Slabs:* The slabs shall be red or white as specified in the description of the item. The stone slabs shall be hard, sound, durable and tough, free from cracks, decay and weathering. In case of red sand stone, white patches or streaks shall not be allowed. However, scattered spots upto 10 mm diameter will be permitted. Before starting the work the contractor shall get samples of slabs approved by the Engineer-in-charge. The slabs shall be hand or machine cut to the requisite thickness along planes parallel to the natural bed of stone and should be of uniform size if required.

b. **Dressing of Slabs*:*** Every slab shall be cut to the required size and shape, and rough chisel dressed on the top, so that the dressed surface shall not be more than 6 mm from a straight edge when placed on it. The edge of depressions or projections shall be chisel dressed in a slant so that the surface does not have sharp unevenness. The edges shall also chisel dressed to a minimum depth of 20mm so that the dressed edge shall at no place be more than 30 mm from a straight edge butted against it. Beyond this depth the sides may be dressed slightly splayed so as to form inverted `V` shaped joint with adjoining slabs. All angles and edges of the slabs shall be true, square and free from chipings & the surface reasonably true and plane. Where slabs are used for treads without nosing, the exposed edges shall be rough chisel dressed to full depth and cut to uniform thickness. The thickness of the slabs after it is dressed shall be 40 mm or as specified in the description of the item with a permissible tolerance of (+/- 2mm).

c. Laying

i. Base concrete on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be of cement mortar 1:5 (1 cement : 5 coarse sand) or as given in description of the item.

ii. The average thickness of the bedding mortar under the slabs shall be 20 mm and the thickness at any place under the slabs shall not be less than 12 mm.

iii. The slab shall be laid in the following manner: Mortar of specified mix shall be spread under each slab. The slab shall be washed clean before laying. It shall then be laid on top, pressed and larried, so that all hollows underneath get filled and surplus mortar works up through the joints. The top shall be tapped with a wooden mallet and brought to level and close to the adjoining slabs, with thickness of joint not exceeding 5mm. Subsequent slabs shall be laid in the same manner. After laying each slab surplus mortar on the surface of slabs shall be cleaned off and joints finished

flush.

iv. In case pointing with other mortar mix is specified, the joint shall be left raked out uniformly and to a depth of not less than 12 mm when the mortar is still green. The pointing shall be cured for a minimum period of 7 days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Engr.-in-charge.

v. Slabs that are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster, skirting or dado. The junction between wall plaster skirting and floor shall be finished neatly and without waviness.

vi. The finished floor shall not sound hollow when tapped with wooden mallet.

d. **Finishing:** Any unevenness existing between the edges of slab joints shall be removed by chiselling in a slant.

e. **Measurements:** The flooring work shall be measured in square metre correct to two places of decimal. Length and breadth shall be measured correct to a cm 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. Nothing extra shall be paid for laying the floor at different levels in the same room / area.

f. **Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above. Where pointing is to be done, this will be paid extra unless specifically included in the description of the item.

* * *

28 PVC SHEET / TILES FLOORING :

28.0. **P.V.C** Flooring material gives a resilient and non-porous surface which can be easily cleaned with a wet cloth as dust and grime do not penetrate the surface. Since a burning cigarette will damage the neat surface of the PVC sheet, special care should be taken to prevent burning cigarette stumps to come in contact with the PVC flooring materials. It shall be laid on a base that is finished even and smooth such as concrete, metal or timber boarding. Unevenness or undulations in the base will show badly on the surface and are liable to damage the P.V.C sheet / tiles.

28.1. Materials

28.1.1. The PVC flooring material shall conform IS : 3462. It may be in the form of tiles, sheets or rolls as specified. It shall consist a thoroughly blended composition of thermoplastic binder, filler and pigments. The thermoplastic binder shall consist substantially of one or both of a) Vinyl chloride polymer and b) Vinyl chloride copolymer The polymetric material shall be compounded with suitable plasticizers and stabilizers

Thickness : The preferred thickness of PVC tiles for normal floor covering shall be 1.5, 2.0, 2.5, 3.0 or 4.0 mm.

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

- For sheets and rolls the thickness of the specimen shall be measured at twenty scattered points.

- For polystyrene wall tiles, the cavity depth of the test specimen shall be measured at five points taken at random on the rear surface of each tile with a suitable depth gauge.

28.1.3. The width of flooring sheets and rolling in continuous length shall be 1000, 1500 and 2000 mm. When supplied in rolls the length of the rolls shall not be less than 10 metre. The measurement shall be carried out with a travelling microscope or suitable scale graduated to 0.02 mm. Each tile shall be measured for length and width at the three quarter point in each direction.

28.1.4. Tolerance

(a)	**In Thickness**	**(+/-)** 0.15 mm
(b)	**In Width: as under:**	
(i)	300 mm square	(+/-) 0.2mm
(ii)	600 mm square	(+/-) 0.4mm
(iii)	900 mm square	(+/-) 0.6mm
(iv)	Sheets and	(+/-) 0.1 per

28.1.5. Adhesive: Rubber based adhesives are suitable for fixing PVC flooring over concrete, wooden and metal sub-floors. PVA based adhesives shall be used for concrete and wooden sub floors. PVA based adhesives are not suitable for metallic surfaces and also for locations where there is constant spillage of water.

28.2. Preparation of Sub-Floors: Before laying PVC sheets / tiles, it is essential to ensure that the base is thoroughly dry and damp proof as evaporation of moisture can not take place once the PVC flooring is laid. Moisture slowly damages the adhesive resulting in PVC sheet / tiles being separated from the base and curled up. In case of new work a period of 4 to 8 weeks shall be allowed for drying the sub-floor under normal conditions. Concrete sub-floors on the ground floor shall be laid in two layers. The top of the lower layer of concrete shall be painted with two coats of A-90 grade (conforming to IS: 1580) applied at the rate of 1.5 kg/sqm. The top surface of the lower layer shall be finished smooth while laying the concrete so that the bitumen can be applied uniformly. The bitumen shall be applied after the concrete has set and is sufficiently hard. Bitumen felt conforming to IS : 1322 shall be sandwiched in the sub-floor laid in two layers.

In new concrete floor, the smooth finish required shall be produced by using cement slurry spread on fresh concrete floor and finished smooth. If the concrete floor is old

and surface not even, the surface should be made smooth by first cleaning it free of all foreign material and then a layer of cement mortar 1:2 of average thickness of 6 mm shall be applied on the surface finishing the surface smooth. The finished surface shall be cured for 7 days and then allowed to dry thoroughly.

Where it is expected that the dampness may find its way from the surrounding walls, the same shall also be effectively damp-proofed upto atleast 150 mm above the level of the sub-floor and the damp proof treatment below the floor shall be extended over the walls.

28.3. Laying and Fixing

28.3.1. Prior to laying, the flooring tiles / rolls / sheets shall be brought to the temperature of the area in which it is to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours.

28.3.2. Where air-conditioning is installed, the flooring shall not be laid on the sub-floor until the conditioning units have been in operation for at least seven days. During this period the temperature shall neither fall below 20^{0}C nor exceed 30^{0}C. These conditions shall be maintained during laying and for 48 hours, there after.

28.3.3. Before commencing the laying operations, the sub-floor shall be examined for evenness and dryness. The sub-floor shall then be cleaned with a dry cloth. The PVC flooring shall not be laid on a sub-floor unless the sub-floor is perfectly dry. Dryness of the sub-floor shall be tested conforming to relevant IS codes and manufacturers recommendations as directed by the Engineer-in-Charge.

28.3.4. The layout of the PVC flooring on the sub-floor to be covered should be marked with guidelines. The PVC flooring shall be first laid for trial, without using the adhesive, according to the required layout.

28.3.5. The adhesive shall be applied by using a notched trowel to the sub-floor and to the back side of the PVC sheet tile flooring. When set sufficiently for laying, the adhesive will be sticky to touch, but will not mark the fingers. In general, the adhesive will require about half an hour for setting. It should not be left after setting for too long a period as the adhesive properties will be lost owing to dust films and other causes.

28.3.6. Care should be taken while laying the flooring under high humidity conditions so that condensation does not take place of the adhesive. It is preferable to avoid laying under high humidity conditions.

28.3.7. The area of adhesive to be spread at one time on the sub-floor depends entirely upon local circumstances. In case of a small room, adhesive may be spread over the entire area but relatively small areas of tiles/sheets flooring should be treated in a larger room.

28.3.8. When the adhesive is just tack free the PVC flooring sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background

surface. After laying the sheet in position, it shall be pressed with suitable roller weighing about 5 kg to develop proper contract with the sub-floor. The next sheet with its back side applied with the adhesive shall be `[laid edge to edge] with the sheet already laid and fixed in exactly the same manner as the first sheet was fixed. The sheets shall be laid edge to edge so that there is minimum gap between joints.

28.3.9. The alignment should be checked after laying of each row of sheet is completed. If the alignment is not perfect, the sheets may be trimmed by using a straight edge.

28.3.10. The tiles shall be fixed in exactly the same manner as for the sheets. It is preferable to start laying of the tiles from the centre of the area. Care should be taken that the tiles are laid close to each other with minimum gap between joints. The tiles should always be lowered in position and pressed firmly on to the adhesive. Care should be taken not to slide them as this may result in adhesive being squeeze up between the joints. PVC tiles after laying shall be rolled with a light wooden roller weighing about 5 kg to ensure full contact with the under layer. Any undulations noticed on the PVC surface shall be rectified by removing and relaying the tiles after thorough cleaning of the underside of the affected tiles. The adhesives applied earlier in such places shall be thoroughly removed by using proper solvents and the surface shall be cleaned to remove the traces of solvents used. Work should be constantly checked against guidelines in order to ensure that all the four edges of adjacent tiles meet accurately.

28.3.11. Any adhesive which may squeeze up between sheets or tiles should be wiped off immediately with a wet cloth before the adhesive hardens. If, by chance, adhesive dries up and hardens on the surface of the sheet or tile, it should be removed with a suitable solvent. A solution of one part of commercial butyleacetate and three parts of turpentine oil is a suitable solvent for the purpose.

28.3.12. A minimum period of 24 hours shall be given after laying the flooring for developing proper bond of the adhesive. During this period, the flooring shall not be put to service. It is preferable to lay the PVC flooring after completion of plastering, painting and other decorative finish works so as to avoid any accidental damage to the flooring.

28.3.13. When the flooring has been securely, fixed, it shall be cleaned with a wet cloth soaked in warm soap solution (two spoons of soap in 5 litres of warm water).

28.3.14. When the edges of the PVC sheets or tiles are exposed, as for example, in doorways and on stair treads, it is important to provide protection against damage of flooring materials. Metallic edge strips may be used and should be securely fastened to the sub floor to protect edges of the flooring.

28.4. Precaution for Maintenance

28.4.1. PVC flooring subject to normal usage may be kept clean by mopping with soap solution using a clean damp cloth. Water shall not be poured on the

PVC flooring for cleaning purpose as the water may tend to seep through the joints and cause the adhesive to fail. To maintain a good wearing surface a good appearance, the flooring may be periodically polished. When polish is applied frequently, a thick layer builds up which collects dirt and dust and is tacky to walk on.

28.4.2. If the traffic is light, the floor shall be given frequent brushing regular polishing by an application of new polish every 4 to 6 weeks. Under moderate traffic conditions the floor shall be given an occasional wash with a wet mop but no detergents shall be used so that the polish is not removed.

Application of polish may be done every one to three weeks. PVC flooring should not be over waxed. When this condition develops, the coatings should be cleared off with white spirit or paraffin and a light even coat of polish applied. When the PVC flooring has been polished, it will remain bright for a considerable period if dry mop is applied each day. It is this daily `dry polish` that maintains the glossy surface. After exceptionally heavy traffic PVC flooring should be swept with a hair broom, rubbed with a mop or cloth frequently rinsed in clean water and finally rubbed dry.

28.5. Measurements: Length and breadth shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for 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. Nothing extra shall be paid for providing PVC flooring in borders and margins, irrespective of their width.

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

28.7. PVC Asbestos Floor Tiles: Material, Dimensions and Tolerance, colour and finish, physical requirements and test shall be as per IS:3461 and the rest shall be as per specification for "PVC Sheet / Tile Flooring" as described above.

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29 LINOLEUM FLOORING

29.0. Linoleum may be used on any base that is finished even and smooth, such as concrete, timber boarding or mastic asphalt. Unevenness or undulations in the base will show badly on the surface even and are liable to damage the linoleum. Linoleum flooring is suitable only for locations wholly inside the building. Linoleum is not resistant to indentations from heels or static load. Heavy objects left in one position may leave indentations. As linoleum flooring can become dangerously slippery when highly polished or wet, care should be taken to use polish with reduced tendency to slipperiness. If full damp proofing of the base surface can not be ensured, the linoleum should not be used for floor covering. Linoleum is a combustible material and should not be used where an incombustible flooring is required. Linoleum flooring is a specialised work, which shall be carried out through specialist firms.

29.1. Materials

29.1.1. Linoleum: Linoleum shall conform in all respects to IS: 653. Linoleum shall be of thickness specified in the description of the item. Linoleum shall be of either plain, moire, jaspe or marble type or a combination of the above types as shown in drawings or as directed by the Engineer-in-charge.

Linoleum shall be stored in a clean, dry & well-ventilated place without exposure to direct sunlight as directed by the Engineer-in-charge. Before starting the work the contractor shall get the samples of Linoleum approved by the Engrin-ch.

Recommended thickness: Linoleum used shall be of a thickness adequate for the conditions of surface and situation. The following thickness shall generally be used.

S	SITUATION	THICKNES
a)	For public buildings, cinemas, restaurants, ships and	6 to 6.7 mm
b)	For offices, shops and the like, depending upon the	3.2 to 4.5
c)	For residential house	3.2 mm

29.1.2. Adhesive: The adhesive used for laying the linoleum shall be those recommended by manufacturers of the floor covering and shall conform to specifications laid down for adhesive in IS: 1198. It shall be of heavy consistency and of reasonably short drying time.

29.2. Laying: It shall conform to IS: 1198.

29.2.1. Before laying linoleum it is essential to ensure that the base is thoroughly dry and damp proof as per relevant IS and/or as directed by the Engineer-in-Charge, as moisture slowly rots the base and damage the adhesive resulting in the linoleum being separated from the base and curled up. Damp proofing where required may be either with an impervious membrane incorporated in the thickness of the base or with a layer of mastic asphalt of 12.5 mm minimum thickness spread and finished even and smooth on the concrete or other base.

29.2.2. Linoleum shall be kept at a temperature of not less than 20^0C for at least 48 hours before it is unrolled. Linoleum shall be unrolled and loose laid out flat for 2 to 3 days before it is cut to size, as it shrinks in length and expands in width after rolling. Till the expansion of spread roll stops, the two widths of linoleum should be allowed overlap and after the expansion stops it should be cut to fit. Laying should be taken up only after the sheets are finally cut to size after expansion is stopped. Linoleum pieces shall be cut to the required size and shapes with a sharp straight edge and gauge as explained below and laid dry to the margin and pattern as shown in the drawings or as directed by the Engineer-in-charge.

29.2.3. The length for borders shall be first cut and adjusted. Linoleum shall then be adjusted in the central portion with their edges overlapping the adjacent pieces by about 12 mm. The edges shall then be cut with the help of

a special instrument called the `Gauge` which enables the marking of the edge of the top pieces exactly over edge of the adjacent piece, so that when the overlapping is cut along the line, the edges of adjacent sheets butt against each other without any gap, what so ever.

29.2.4. Adhesive shall then be brushed over the base, which shall have been thoroughly cleaned in advance, and shall be allowed to become tacky. The sheets shall then be firmly pressed down and rolled with a light cast iron 70 kg roller, to ensure that they stick evenly to the base and no air pockets are left under them. If any air pockets are left, the sheets shall be removed and re-laid after brushing more adhesive on the base and roll. The sheets shall be laid with butt joints throughout and the joints shall be very fine. Sandbags shall be placed over the edges and joints to keep the sheets pressed down and prevent curling. Linoleum shall not be used for coves, skirting and dado.

29.2.5. Coves of wood or metal may be formed to cover or mask the joints between the linoleum flooring and the wall facing where so required, but this shall be paid for separately.

29.3. **Finishing:** After laying, any adhesive contaminating the face of the sheets shall be removed immediately with kerosene oil or spirit. The flooring shall be cleaned with soap and wet cloth wiped dry. It shall then be wax polished to give a smooth shining surface, taking care to endure that the flooring does not become slippery due to excessive polish.

29.4. **Precautions:** Linoleum shall not be creased, as it will crack. Excess water, which is liable to creep into the joints and strongly alkaline soaps, shall not be used for cleaning. Mild bar soap may be used. Linoleum shall be handled carefully with its exposed face protected from damage by sharp points.

29.5. **Measurements:** Length and breadths of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. No deductions 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.

29.6. **Rate:** The rate shall include the cost of all materials and labour involved in all the operations described above but will not include the cost of sub-base floor or damp proof treatment stated above.

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30 WOODEN FLOORING

30.0. **Seasoning and Preservation:** All timber used for timber floors shall be thoroughly seasoned in accordance with IS : 1141. After seasoning, the timber shall be treated with preservative in accordance with IS : 401. Seasoning and preservative treatment shall not be paid for separately and the rate quoted for the item shall be

inclusive of the same.

30.1. Supporting Joists: Main beams and joists of the class of wood sections specified in the description of the item for beams and joists, or as instructed by the Engineer-in-charge shall be fixed in position to dead levels. The width of the joints shall not be less than 50 mm. The arrangement and spacing of beams, joists etc. shall be as per design furnished.

30.2. Boards: It shall be of the class of timber and thickness specified in the description of the item. The timber shall be as specified in *preceding chapters for wood work.* Only selected boards of uniform width shall be used. Unless otherwise specified or shown in the drawings, the width of boards selected shall not be less than 100 mm nor more than 150 mm. The same width of boards shall be maintained throughout except where the width of the room is not an exact multiple of the boards. In the latter case, the difference shall be equally adjusted between the two end boards (adjacent to walls). The length of the boards shall not exceed 3 metre anywhere. Ordinarily, the minimum length of boards shall be such that the boards shall rest at least on three supports, except where otherwise required by the pattern specified in the drawings or as directed by the Engineer-in-charge.

The boards shall be planed true on the top face only unless otherwise specified in the description of the item. Where the bottom face is exposed and it is also required to be planed, then such planing shall be paid for extra. Unless otherwise described in the item, the longitudinal joints of planks shall be tongued and grooved to a minimum depth of 12 mm while the heading joints shall be of the square butt type and shall occur over the centre line of the supporting joists. Heading joists in adjacent boards shall be placed over the same joists.

30.3. Iron Screws: Iron screws shall be of the slotted counter sunk head type, of length not less than the thickness of planks plus 25 mm subject to a minimum of 40 mm, & of designation of No.9 conforming to IS :451.

30.4. Fixing: The joists on which the planks shall be fixed shall be checked and corrected to levels. The end boards shall be accurately fixed with the sides parallel and close to the walls. Each adjoining board shall be carefully joined and shall be tightened in position and screwed. For fixing the boards to the joists, two screws shall be used at each end of the boards and one screw at each of the intermediate joists in a zigzag manner. The screws shall be countersunk and screw holes filled with approved stopping.

The junction between timber flooring and adjacent flooring shall be formed by inserting a metal strip (brass or aluminium) at the junction. The metal strip shall be fixed to the end of the planks by screws. The strips shall be paid for extra. The flooring shall be truly level and plane. The joints shall be truly parallel and or perpendicular to the walls, unless otherwise specified. The floor shall be planed in both directions and made perfectly even, true and smooth.

NOTE : No wood of any kind shall be placed within 60 cm of any fire place or flue. Provision shall be made for ventilating the space below the floor in case of ground floor and between and top of ceiling in the case of upper floors. Such arrangements shall be paid for separately.

30.5. Finishing: The surface of the floor shall be bees waxed or finished otherwise as directed by the Engineer-incharge. The lower face shall be painted or treated with wood preservative as directed. The finishing shall be paid separately unless specifically included in description of the flooring item.

30.6. Measurements: Length and breadth of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in sqm correct to two places of decimal. 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.

30.7. Rate: The rate shall include the cost of labour and materials involved in all the operations described above, with the exceptions noted in the relevant sub paras.

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31 WOOD WORK IN FRAMES, SHUTTERS AND PANELLING :

a. WOOD WORK :

All timber mentioned in the item in schedule of quantities shall be from the heart of a sound tree of nature growth entirely free from sap wood. It shall be uniform in texture, straight in fiber and shall be well and properly seasoned. It will be free from large, loose, dead or cluster knots, wedges, injuries, open shakes, borer holes, rot, decay date, discoloration, soft or spongy spot, hollow pockets, pith or centre bore and all other defects or any other damages of harmful nature which will affect the strength, durability, appearance and its usefulness for the purpose for which it is required. **Only properly seasoned timber shall be used**.

TEAK WOOD:

First Class Teak Wood: Individual hard and sound knot shall not be more than 25mm in diameter and aggregate area of all knots shall not exceed one percent of the area of the piece. Sapwood shall not be allowed.

Second Class Teak Wood: Individual hard and sound knot shall not be more than 40 mm in diameter and aggregate area of all knots shall not exceed one and half percent of the area of the piece. Wood shall be generally free from sapwood, but traces of sapwood may be allowed.

HARD WOOD:

No individual hard and sound knot shall exceed 25mm in diameter and aggregate area of all knots shall not exceed one percent of the area of the piece. Sapwood is very perishable and should not be used.

The samples of species to be used shall be deposited by the contractor with the Engineer-in-Charge before commencement of the work. The contractor shall produce cash vouchers and certificate from standard kiln seasoning plant operator about the timber section to be used on the work having been kiln seasoned by them, failing which it would not be so accepted as kiln seasoned. Seasoning of timber shall be

judged from its moisture content as laid down in I.S. 287. The seasoning of timber shall conform to I.S.1141 -1 993. Scantling of all types of timber shall be straight. Warped scantling shall not be used. Before use in works, the scantling shall be kept in covered and well-ventilated place and shall be got approved.

The workmanship shall be of best quality. All wrought timber is to be sawn, planed, drilled or otherwise machine worked to the correct sizes and shall be as indicated in drawing or as specified. All joinery work shall fit truly and without wedging or filling. Wood work in frames shall be wrought. All frame joints shall be put together with white lead and pinned with hard wood pins securing with corrosion resistant star shaped metal pins as approved by the Engineer-in-charge. If after fixing in position, any shrinking or substandard materials or bad workmanship is detected, the contractor shall, forthwith remove them and replace the same at his own cost, all as directed by the Engineer-in-charge.

Individual members shall be of continuous length. The finished size and sections shall be as per drawing or as specified. The heads and posts of frames shall be through tennoned into the mortises to the full widths as shown in the drawing. All necessary mortising, tennoning, grooving, matching, tonguing, housing rebate and other necessary works for correct jointing shall be carried out, in the best workmanship like manner. Joints not specifically indicated shall be recognised form of approved joints for each position. The door frames shall be provided with 6 nos. approved iron hold fasts, fabricated out of 30 x 3 mm. section, 300 mm. long (150 mm. long for cross partitions) M.S. flats with spliced end in case they are abutting brick masonry works. These M.S. hold fasts shall be embedded in plain cement concrete 1:3:6 block of size 300 x 75 mm. depth (100 x 75 mm. for cross partitions) and for full width of brick masonry. For frames abutting concrete surfaces, 6 nos., 100 mm. long coach screws with sunk heads minimum 10 mm. from face of frames, shall be provided. Each screw shall be secured in concrete with lead wool sufficiently stuffed in the pre-drilled holes to receive the screws. Top member of door frames for opening exceeding 1.25 m. in width, shall be secured with a coach screw 100 mm. long in centre of member. All other T.W. scantlings shall be fixed to structural openings with wood screws of suitable size & rawl plug so as to get in effective hold of at least 40 mm. Suitable teak wood plugs shall be provided to conceal the screw heads. The door frame shall rest on concrete sub- base in ground floor or structural floor slab in case of upper floors, the extra length of sides of frames thus embedded below finished floors shall not be measured for payment. All parts of wood work resting on or set in masonry or concrete shall be well painted with two coats of bituminous paint or solignum as directed by the Engineer-in-charge, prior to installations. All nails, screws, hold fasts, plates, plugs, pins required for wood work joinery and fixing work, shall be provided by the contractor, at his own cost. All materials shall be approved by Engineer-in-charge before using in works. Painting of door frames shall be carried out as per specifications for painting for wood work.

All the embedded timber shall be given two coats of hot tar or solignum before erection. This is incidental to the item and shall not be measured for payment.

b. TEAK WOOD PANELLED SHUTTERS :

Teak wood door shutter shall generally conform to standard laid in I.S. 1002 or the latest revision for requirements of materials, construction workmanship and shall be of specified thickness and of 1st class C.P. teak wood of approved design with stiles, top, bottom and lock rail generally as per drawing. Wherever shown, each panel shall be in a single width piece, but when two or more pieces have to be used and are permitted, all of them shall be of equal width and shall be jointed with a tongue and groove joint with chamfered edges glued together and reinforced with metal dowels.

c. TEAK WOOD GLAZED SHUTTERS :

The specifications for teak wood panelled shutter shall generally apply to glazed shutters for frame, stiles etc.

The sash and beading required for glazing shall be of the best teak wood and shall be fixed as per the design shown in relevant drawing. Any mouldings, carvings shown shall be worked out from the teak wood member of bigger size.

d. GLAZING :

Glazing shall be generally with 4 mm. thick plain sheet glass/bajra glass unless otherwise mentioned in the schedule of quantities. The detailed specifications for glazing given hereafter shall be followed generally.

e. FLUSH DOOR SHUTTERS :

Solid core flush door shutters shall be of 5 ply construction and approved make generally conforming to the I.S. specification 2202-1991 (specification for wooden flush door shutter- solid core type). The finished thickness of the shutter shall be as mentioned in the schedule of items.

f. FACE VENEERS :

Commercial face veneers used in flush door shutter shall conform to the requirements laid down in I.S. 303 -1989 specifications for ply wood for general purposes (revised) interior grade.

Decorative face veneers used in flush door shutters shall be of grade - I and shall conform to the requirements of decorative veneer specified for grade - I decorative ply wood in I.S. 1328 - 1982 specifications for veneered decorative ply wood interior grade. Thickness of veneers shall not exceed 1 mm.

g. ADHESIVES :

Phenol formaldehyde synthetic resin (liquid type adhesives) conforming to I.S. 848 specifications for synthetic resins shall be used for bonding.

h. LIPPING :

The lipping shall be of best quality hard wood variety unless otherwise mentioned. In case teak wood lipping is mentioned in the schedule of quantities, it shall conform the specification for best quality teak wood. The internal lipping alround the shutter sides shall be one piece of size not less than 25 mm. wide and depth

equal to the thickness of core. In case of double leaf shutters, the meeting stiles shall have lipping of not less than 35 mm. deep. **Thickness of external lipping, wherever specified in the item, shall not be more than 10mm and not less than 6mm.**

i. WORKMANSHIP AND FINISH :

All the faces of the door shutter shall be at right angles. The shutter shall be free from twist and warp in its plane. Both faces of the door shutters shall be sanded to a smooth even texture. The workmanship and finish of the face panels shall be in conformity with those specified in I.S. 303 - 1989 specification for plywood for general purpose (revised) for commercial type and I.S. 1659 - 1990 specification for block boards for decorative type.

j. TESTS :

Tests shall be conducted as per mandatory test requirement, by the Contractor at Approved Lab at contractors cost and acceptance criteria shall be as per I.S. 2202. The flush door shutters manufactured shall be inspected for its quality and workmanship and tested at the factory before dispatching. All facilities shall be extended for such inspection and testing. The sampling and testing shall be as per the IS requirements and all costs towards test including sample for destructive tests shall be borne by the contractor.

k. TOLERANCE :

Tolerance on nominal width and height shall be (+/-) 3 mm. Tolerance on nominal thickness shall be (+/-) 1.5mm. The thickness of the individual shutter shall be uniform throughout.

l. MISCELLANEOUS :

Wherever mentioned in the Schedule of quantities, vision panels, venetians, plastic laminates, push plates etc. shall be provided in the flush doors.

The vision panels shall be of size mentioned in the drawing and shall be provided with teak wood lipping alround the glass. The glass shall be 4 mm. thick or as specified of best quality (M/s. Triveni, I.A.G., Shree Vallabh or equivalent approved), free from defects.

Teak wood venetians or louvers shall generally conform to relevant specifications of timber. Necessary grooves and rebate in frames shall be provided as per drawing.

Formica or approved equivalent plastic laminate of required design, required shade and colour shall be provided and fixed on flush door to the required size on any side of the shutter as shown in drawing. It shall be fixed with Fevicol or any other approved adhesive. Fixing shall be done in such a way that there shall not be any air gap, warpage or undulations on the surface. Finished surface of formica shall be cleaned with wax polish.

The shutters shall be painted on commercial facing side with two coats of synthetic/flat oil paint of approved shade and make over an approved coat of primer.

The decorative veneer side of the shutter shall be wax or french polished with two or more coats so as to render a satisfactory surface.

The flush doors shall be single leaf or double leaf type as mentioned in the schedule of quantities. In case of double leaf shutters, the meeting of the stiles shall be rebated 20 mm. and shall be either splayed or square type and the T.W. lipping around the meeting shall not be less than 35 mm. deep. The meeting stiles shall be in single piece.

Sufficient care shall be taken to prevent any damage and loss of shape during handling, transporting, stacking, fixing etc. The door shutters shall be handled with utmost care to prevent any surface damage, warping etc.

m. MODE OF MEASUREMENT :

The work covered under the respective items in schedule and the above specifications shall be measured as follows :

The cubic contents for wood work shall be measured for the finished size, limiting to those shown in the drawings or ordered by the Engineer-in-charge. The cross sectional dimensions shall be measured equivalent to nearest enclosing rectangle (least rectangle/square) for wrought and planed sizes. The cubical content shall be worked out correct upto three places of decimals of a cubic metre. The frames embedded below finished floor shall not be measured.

The square meter areas for shutters shall be measured for the exposed surfaces of shutter between frames from inside or outside whichever is more. The linear dimensions shall be measured upto two places of decimals of a metre. The area for payment shall be worked out correct upto two places of decimals of a square metre. The rate for shutters shall include:

i. Cost of supply assembly and erecting in position.

ii. Cost of polishing, painting, supplying wood preservative, screws, nails, hold fasts etc.

iii. Cost of labour for making adjustments in frames, if required, shutters and also for fixing required fittings and fixtures.

iv. In case of flush doors, the rate for individual item mentioned in the schedule of quantities shall include cost of shutters, labour for provision of glass for vision panel, plastic laminate sheet push plate, teak wood louvers etc., transporting charges and labour for fixing of fixtures and fastenings except fixing of door closers and painting and polishing as specified.

* * *

32 PRESSED STEEL DOOR FRAME :

a. Scope of work : This specification lays down the requirements regarding material, dimensions and construction of steel door frames for internal and external use.

b. **Material :** Steel door frames shall be manufactured from commercial mild steel sheets of 1.25 mm. thickness, conforming to I.S. 513 (Spn. for cold rolled carbon steel sheets) or I.S. 1079 (Spn. for hot rolled carbon steel sheet and strip). Sheets shall be galvanised for 240 g / Sqm. Zinc deposit on its surface including both sides

as per IS 277 – 2003. Fire Rated steel door of Fire Rating as per requirement shall be of approved make and complete as per manufacturers specification.

c. Standard sizes, Tolerances and Designations :

Sizes : The overall sizes and types of door frames shall be as shown in drawings. 5 mm. clearance on all the four sides shall be allowed for the purpose of fitting the frame into modular openings.

Tolerances : The sizes indicated in drawings for door frames shall not vary by more than (+/-) 2 mm.

d. **Profile :** Steel door frames with or without fanlight shall be made in the profile as per I.S. 4351 (latest version) as per drawings. Any of the three profiles mentioned in I.S. 4351 or sizes specified in the schedule of work may be supplied to suit doors of either hand, opening inwards or outwards, as specified or directed.

e. **Construction :** Each door frame shall consist of hinge jamb, lock jamb, head and, if required, angle threshold. The whole shall be rigidly fixed together by mechanical means. Where no angle threshold is required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit.

f. **Base ties and angle thresholds :** Base ties shall be of pressed mild steel 1.25 mm. thick adjustable to suit floor thickness of 25, 30, 35 or 40 mm. and removable, or alternatively, thresholds of mild steel angle of section 50 x 25 mm., minimum, shall be provided for external door frames.

g. **Fittings:** Fixing Lugs: There shall be three adjustable lugs with split end tail to each jamb without fanlight, and four for jamb with fanlight. The head of the fixing lug shall be of 120 mm. long and shall be made from flat steel strip 25 mm. wide and not less than 1 .60 mm. thick.

The tail of the lugs for use with door frame profile shall be 200 mm. long and shall be made of steel strip not less than 40 mm. wide and not less than 1.0 mm. thick.

Mortar Guards: Mortar guards specified in the tender shall be provided. These shall be welded to the frame at the head of the frame for double shutter doors to make provision for bolts.

Note: The term 'double-shutter doors' indicates 'Pairs of side-hung doors', that is, two side-hung doors mounted in one frame thus forming a two-leaf door rebated together at the lock strike.

Lock Strike Plate: There shall be an adjustable lock-strike plate of steel, complete with mortar guard, to make provision for locks or latches complying with the relevant Indian Standards. Lock-strike plates may be of brass when so specified in the tender; otherwise they shall be of galvanised mild steel and fixed at 75 cm. to 90 cm. from finished floor level.

Shock Absorbers: For side-hung door, there shall not be less than three buffers of rubber or other suitable material inserted in holes in the rebate and one shall be located on the centre line of the lock-strike plate and the other two at least 45 cm. above and below the centre line of the lock-strike plate. For double-shutter doors,

there shall be two buffers of rubber or similar suitable material inserted in holes in the rebate in the lock jamb only at the head and spaced 15 cm. at either side of the centre line of the door.

h. **Mode of Measurements :** The length shall be measured in running metres correct to a cm. out to out of the frames. Threshold angle/base tie will not be measured for payment, cost of which shall be included in pressed steel frame.

* * *

33 FACTORY MADE PARTICLES BOARD PANELLED DOOR SHUTTERS.

a. **GENERAL :** Factory made particle board panelled door shutters shall be made of kiln seasoned and chemically treated timber as specified generally with stiles and top rails of 100 mm. in width, bottom rail and lock rails of 150/1 75 mm. width and panels made of 12 mm. thick both side commercial veneered teak wood particle board or as specified in schedule of quantities, bonded with phenol formaldehyde synthetic resin adhesive and generally conforming to I.S. 3091.

Factory made shutters, as specified shall be obtained from factories to be approved by the Engineer-in-Charge and shall conform to I.S. 2202 (Part-I). The contractor shall inform well in advance to the Engineer-in-Charge the name and address of the factory where from the contractor intends to get the shutters manufactured. The contractor will place order for manufacture of shutters only after written approval of the Engineer-in-Charge in this regard is given. The contractor is bound to abide by the decision of the Engineer-in-Charge and recommend the name of another factory from the approved list, in case the factory already proposed by the contractor is not found competent to manufacture quality shutters.

The contractor will also arrange stage-wise inspection of the shutters at factory of the Engineer-in-Charge or his authorised representative. Contractor will have no claim if the shutters brought at site are rejected by Engineer-in-Charge in part or in full lot due to bad workmanship/quality. Such shutters will not be measured and paid and the contractor shall remove the same from the site of the work within seven days after the written instructions in this regard are issued by Engineer-in-Charge or his authorised representative.

b. TIMBER :

The timber to be used in door shutters shall generally conform to relevant I.S. specifications for materials, moisture content, seasoning, preservation and workmanship. **Seasoned Timber shall only be used.**

All timber shall be from the heart of a sound tree of mature growth, entirely free from sapwood. It shall be uniform in texture, straight in fiber and shall be well and properly seasoned. It shall be free from large, loose, dead or cluster knots, soft or spongy spots, hollow pockets, pith or centre heart, waves, injurious open shakes, borer holes, rot, decay date, discoloration and all other defects or any other damages of harmful nature which will affect the strength, durability, appearance of its usefulness for the purpose for which it is required.

c. PARTICLE BOARD PANELS :

It shall be of well seasoned teak timber particles of uniform thickness, bonded with liquid phenol formaldehyde synthetic resin adhesive of the hot press type. The particle board shall be either flat plate on press or extrusion type as approved by the E.I.C conforming to the latest I.S. specifications. Panels shall be embedded into frames to a minimum of 12 mm. with 1.5 mm. air gaps.

d. SEASONING AND TREATMENT :

All timber to be used for sills and rails shall be kiln seasoned to the required standards as per I.S. 1141 -1 973.

e. ADHESIVE :

The adhesive for bonding of stiles, rails etc. shall be of highly water resistant type synthetic resins (liquid type) adhesive conforming to relevant specifications for synthetic resins.

f. WORKMANSHIP AND FINISH :

The workmanship shall be of best quality. All members shall be in continues length. All the faces of the door shutter shall be secured and in true planes. All wrought timber is to be sawn, planed, drilled or otherwise moulded work to the correct size and shapes indicated in drawing or as specified. All joinery work shall fit truly and without wedging or filling. All the faces of the shutters shall be sanded to smooth even texture. The finished sizes and sections shall be as per drawing or as specified. The shutters shall be got approved from the Engineer-in-Charge at factory site before carting the same to the site of work. The shutters damaged during the cartage and if any sub-standard materials or bad workmanship is detected, the contractor, shall forthwith remove them and replace the same at his own cost, all as directed by the Engineer-in-charge.

g. 33.7 PRIMER COAT :

All factory made panel door shutters with seasoned teak wood/hard wood frame shall be painted with approved Primer coat as per I.S. specifications 1003 (Part-I).

h. TESTS :

Tests shall be conducted as per mandatory test requirement by the E.I.C at the contractors cost. All shutters shall have manufacturer's trade marks.

i. TOLERANCES :

Tolerances on nominal width and height shall be (+/-) 3 mm. Tolerance on nominal thickness shall be (+/-) 1 .5 mm. The thickness of the shutter frame shall be uniform through out with a variation not exceeding 1 mm., when measured at two points.

j. SAMPLES :

Sample of door shutter shall be got approved before manufacturing on large scale.

k. FIXING:

The shutter shall be fixed to teak wood or rolled M.S./EZ door frame (teak wood/rolled steel in door frames paid under relevant items) with necessary fittings as per drawing (cost of fittings and fixtures paid under relevant items). The shutter shall be painted as specified. The shutters of specified thickness and of required sizes as fixed in position as shown in drawing/schedule of quantities shall be measured for payment. The length and width of the shutter fixed in position shall be measured correct upto three places of decimal of a metre and the areas so worked out shall be corrected upto two places of decimal of a square metre. The area of the shutter shall be measured for the exposed surfaces of shutter between frames from inside or outside whichever is more.

l. RATE TO INCLUDE :

The rate quoted by the contractor shall be :

i) or supplying and fixing in position of finished shutters with necessary fittings and fixtures as per drawings (excluding cost of fittings and fixtures which shall be paid under relevant items).

ii) painting/polishing as specified and as directed by the Engineer-in-charge.

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34 GLASS FIBRE REINFORCED PLASTIC (GRP) PANEL TYPE DOOR SHUTTERS

(FOR INTERNAL USE)

a. SCOPE

The specification for Glass Fibre Reinforced Plastic (GRP) Panel Type Door Shutters shall generally conforming to IS 14856 and other associated IS Codes as regards to types, sizes, material, construction, workmanship, finish, performance requirements and sampling etc. for use in residential and industrial buildings, except the large size door shutters for industrial and special buildings like workshops, garages, godowns, etc.

b. **REFERENCES:** The above cited IS 14856 shall be referred with its associated codes.

c. TERMINOLOGY

Aggregate Defects: Presence of impurities such as pin holes, impurities and traces of mending more than 5 each or 5 in aggregate for defects at localized place.

Blistering: Air or solvent entrapped during moulding.

Colour Blots: Colour blots occurring on account of uneven distribution of colouring material.

Crazing: Fine hair cracks on the surface.

Defective Impregnation: Imperfect impregnation of glass fibre with unsaturated polyester resin.

Gelcoat: A gelcoat of UV stabilized, fire retardant, isophthalic quality mixed with 1 5'percentby weight, aerosil powder (500 micron ground silica) suitably formulated to high viscosity given to exposed exterior sections of the moulded door shutter to provide a smooth glossy finish, enhance aesthetics and improve weathering and water resistant properties of the moulded door shutter. The thickness of the coat shall be between 0.35 to 0.40 mm.

Impurities: Foreign matter present, other than specified.

Laminate: A reinforced resin sheet or moulding.

Pin Holes: Pores of size less than 1mm appearing on the surface.

Small Pores: Pores of size more than 1mm appearing on the surface.

Wrinkle: A slight ridge or furrow on surface.

Base Block: A wooden or suitable material provided within the door/shutter frame to facilitate fixing of fittings and other accessories.

RTM Process: Resin Transfer Moulding includes all forms of resin injections, resin infusion vacuum infusion and vacuum press moulding. Moulding is done in a closed mould under differential pressure.

Hand Lay Up: Hand Lay up process consist of laying gelcoat with appropriate layers of Chop Strand Mat (CSM) and resin in open moulds.

d. **HANDING:** Handing and direction of closing of shutters shall be designated in accordance with IS 4043.

e. MATERIAL

Glass Fibre Chopped Strand Mat (CSM): The glass fibre chopped strand mat used shall be as per IS 11551.

Glass Fibre Rovings: The glass fibre rovings shall be as per IS 11320.

Isophthalic Resin: Isophthaiic resin shall be of fire retardant grade as per IS 6746.

Curing Agents

1. Catalyst used shall be Methyl Ethyl Ketone Peroxide (MEKP), benzyl peroxide, acetyl aceto peroxide, etc.

2. Accelerator used shall be cobalt napthalate, cobalt octonate, N.N. dinethyl anilene, etc.

Fillers and Additives

1. Permissible fillers are fiench chalk powder (Talc) and calcium carbonate.

2. Aluminium trihydrite, antimony trioxide, minimum 5 percent, by weight of isophthalic resin, shall be used for fire retardancy.

3. The fillers and additives content shall not exceed 10 percent by weight of isophthalic resin.

Auxiliary Chemical: Polyvinyl alcohol (PVA) or other semipenetrant release agents and wax shall be used as a mould release agent.

Pigments: Pigments compatible with isophthalic resin and gelcoat shall be used to obtain the shade of finish as mutually agreed between the manufacturer and the purchaser.

Base Blocks: Base blocks for fixing fixtures in shutter with screws shall be of seasoned and treated hard wood or any other suitable material.

Polyurethane Foam: Slabs of minimum density of 32 kg/cum and of thickness 4 mm less than the shutter thickness with (+/-) 0.5 mm tolerance shall be used.

f. CONSTRUCTION / FABRICATION

i. The GRP shutter shall have hollow rails and stiles monolithically cast with panels.

ii. The shutters shall be contact moulded by either hand lay up or Resin Transfer Moulding (RTM) process in two pieces as shown in Fig. 1. The process shall consist of laying gelcoat of 0.35 mm to 0.40 mm thickness laid over with three layers of GRP mat (one layer of 300 CSM mat and two layers of 450 CSM) for each of the web (panel) portion and four layers of GRP mat for the flange (rails and stiles) portion (one layer of 300 CSM mat and three layers of 450 CSM mat). While closing the two pieces, additional layer of 450 CSM mat shall be provided in the web portion. The CSM mat shall be bonded with isophthalic resin in the ratio not less than 1:2 (one part of mat to two parts of isophthalic resin and fillers and additives) by weight. The edges shall be sealed with gelcoat and FRP mat to obtain smooth finish. Sufficient rovings shall be laid in the corners to have smooth curve while laying the CSM mat. If the shutter is moulded using the RTM process, then moulding shall be done either by laying gelcoat followed by laying of the GRP mat. Core material shall be placed in location in the hollow sections. The GRP mat shall be bonded by injecting under pressure isophthalic resin in a ratio not less than 1:2 (one part of mat to two parts of isophthalic resin). Alternatively, if the shutter is moulded without using gelcoat then the process is to lay the FRP mat in the mould with the core material blocks in location in the hollow section. The GRP mat shall then be bonded by injecting under pressure, isophthalic resin in a ratio not less than 1:2 (one part of mat to two parts of isophthalic resin).

iii. Blocks of any seasoned hardwood of bulk density not less than 450 kg/m3 at 12 percent moisture content or any other material of sufficient thickness and length shall be provided inside the shutter at suitable place to hold fittings and fixtures such as aldrops, tower bolt, handle sliding door bolt, mortice lock, etc. Blocks for hinges shall be provided at three locations, unless otherwise specified by the purchaser. One at the centre and other two at 200 mm from the top and the bottom of the shutter.

iv. Blocks shall be provided at predetermined places in the shutter so as to fix hinges, mortice locks, tower bolts, aldrops, door closures, etc.

v. The finished surface shall be buffed and polished 3 IS 14856:2000 with wax.

g. DIMENSIONS, SIZES AND TOLERANCES

i. **Dimensions of Components and Tolerances:** The finished dimensions and tolerances of the different components of door shutter shall be as given below:

Dimensions and Tolerances of Components of Door Shutters

SN	**Description**	**Width** (in mm)	**Thickness** (in
i	Vertical stile, top and freeze	90 (+/-) 3	30 (+/-) or 35
ii	Lock rail	120 (+/-) 3	30 (+/-) or 35
iii	Bottom rail	150 (+/-) 3	30 (+/-) or 35

Minimum thickness of GRP laminate of **hollow rails and stiles** shall be 3 mm.

Minimum thickness of GRP laminate used for **panel in the shutter** shall be 5 mm.

ii. **Sizes and Types:** Sizes and types of the shutters shall be generally as per working drawings issued for the work or shall conform to the modular sizes as per IS 14856.

iii. **Tolerances:** Tolerances on the sizes of door shutters shall be _~mm.

h. LOCATIONS OF FI'ITINGS AND ACCESSORIES

i. The lock rail of door shutters shall be so placed that its

centre line is at a height 850 + 5 mm from the bottom of the shutter.

ii. Each door shutter shall be fixed to the frame with three hinges of the type specified, unless otherwise specified. These location shall be, one at the centre and other two at 200 mm from the top and the bottom of the shutter, where blocks have already been provided and suitable indication, by depressing the profile has been made.

iii. Other fixtures shall also be provided at the locations where blocks have already been provided

i. FINISH

i. The surface of the moulded shutters shall be free from any visible defects such as small pores, crazing, blistering, wrinkling, impurities, defective impregnation, colour blots and aggregate defects.

ii. Scattered pin holes duly repaired and finished by applying resin and not noticeable shall be acceptable.

iii. Panels, rails and stiles of the door shutters shall be flat and shall have smooth and level surface.

iv. Shutter shall be finished in colour & design as specified in the agreement item.

j. TESTS

i. **Tests on Material:** Following tests shall be conducted on FRP laminate (without removing gel coat) cut from door shutter. The method of carrying out the test shall be as per the reference code mentioned against each test. Acceptable criteria shall be as mentioned against each test.

Tests on GRP Laminate

***SI* No.**	**Tests (as per IS requirement)**	**Acceptable Value**
i)	Fibre glass content Annex B	25 percent (M*in*)
ii)	Barcol hardness Annex C	30 BHU *(Min)*
iii)	Tensile strength Annex D (MPa)	100 *(Min)*
iv)	Bending strength Annex E (MPa)	120 (M*in*)
v)	Elastic modulus Annex F in bend	*1* 500 (M*in*)
vi)	Water absorption Annex G	0.5 percent (Max)
vii)	Fire retardancy Annex H	100 mm length of the specimen

ii. Requirements on Shutters

The following tests in accordance with IS 4020 (Parts 1 to 16) shall be conducted on the door shutters:

1. ***Dimensions and Squareness Test:*** Door shutters, when tested in accordance with 1S 4020 (Part 2), the dimensions of nominal width and height shall be within a limit of (+/-) 5mm. The door shutter shall not deviate by more than 1mm on a length of 500 mm. The thickness of the door shutter shall be uniform throughout with the permissible variation of not more than 0.8 mm between any two points. The nominal **thickness** of the shutter shall be within a limit of (+/-) 1.5mm.

2. ***General Flatness Test*** Door shutters, when tested in accordance with IS 4020 (Part 3), the twist, cupping and warping shall not exceed 6 mm.

3. ***Local Planeness Test:*** Door shutters, when tested in accordance with 1S 4020 (Part 4), the depth of deviation measured at any point shall not be more than 0.5 mm.

4. ***Impact Indentation Test:*** Door shutters, when tested in accordance with IS 4020 (Part 5), shall have no defects such as cracking, tearing or delamination and the depth of indentation shall not be more than 0.2 mm.

5. ***Edge Loading Test:*** Door shutters, when tested in accordance with IS4020 (Part 7), the deflection of the edge at the maximum load shall not be more than 5 mm. On removal of the loads, the residual deflection shall not be more than 0.5 mm, failing which the test may be repeated on the other edge in the reverse direction. Also there shall be no lateral buckling by more than 2 mm during loaded condition and no residual lateral buckling after removal of the load.

6. Shock Resistance Test

1. Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 8), there shall be no visible damage in any part of the door after twenty-five blows on each end.

2. Door shutters, when tested in accordance with 3.1 of IS 4020 (Part 8), the normally hung shutter, with hangings, fixings and fastenings should withstand without any significant permanent deformation and without deterioration the five impacts on both sides of the shutter.

7. **Buckling Test:** Door shutters, when tested in accordance with IS 4020 (Part 9), shall not show

any deterioration and any residual deformation more than 5 mm after 15 min of unloading and the initial deflection also shall not be more than 50 mm.

8. Slamming Test

Anyone of the following tests shall be used.

1. Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 10), shall not have any visible damage in any part of the door at the end of 50 successive impacts.

2. Door shutters, when tested in accordance with 3.1 of IS 4020 (Part 10), shall not have any visible damage in any part of the door at the end of I00 successive impacts.

9. Misuse Test

Door shutters, when tested in accordance with 1S4020 (Part 11), there shall not be any permanent deformation of the fixing or any other part of the door set in hindering its normal working after the test.

k. **SAMPLING AND CRITERIA FOR CONFORMITY:** The sampling and criteria for conformity shall be in accordance with IS 4020 (Part 1).

l. MARKING

1 All door shutters conforming to this specification shall be marked with the following information:

a) Name of manufacturer or trade-mark, if any.

b) Lot number/date of manufacture for identification.

c) ISI Certification mark if any.

m. **MODE OF MEASUREMENT:** Square metre area for shutters shall be measured for the exposed surfaces of shutter between frame work from inside or outside, whichever is more. The linear dimensions shall be measured upto two places of decimals of a metre. The area for payment shall be worked out correct upto two places of decimal of a square metre.

n. **RATE TO INCLUDE:** The rate quoted by the contractor shall include supplying and fixing the shutters including supplying and fixing all fittings and fixtures as per item and / or drawing. Unless otherwise specified, frame work for the shutters shall be measured and paid separately under relevant item.

* * *

35 FITTINGS AND FIXTURES:

a. SCOPE OF WORK :

The work covered under these specifications consist of supplying different types of fittings and fixtures required for doors, windows, ventilators etc. The supply shall be in accordance with the specification, drawings / approved samples. Samples of various fittings and fixtures 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.

b. GENERAL :

All fittings and fixtures shall conform to relevant IS code and made of brass, nodized aluminium, iron oxidised (M.S.) or as specified. These shall be well made reasonably smooth and free from sharp edges, corners, flaws and other defects. Screw holes shall be counter sunk to suit the heads of the specified screws. All hinges pins shall be of steel for brass hinges and aluminium alloy NR-6 or steel pins for aluminium hinges with nylon washers or as specified. All riveted heads pertaining to hinge pins shall be well formed. Screws supplied for fittings shall be of the same metal and finish as the fittings. However brass cadmium plated/chromium plated screws shall be supplied with aluminium fittings. Samples of each fixture/ fitting shall be furnished by the contractor for approval of the Engineer-in-Charge. Order for procurement of fittings and fixtures in bulk shall be placed only after approval by the Engineer-in-Charge.

The fittings and fixtures to be incorporated in the work shall be strictly according to the approved sample. Fittings shall be fixed in proper position as shown in the drawing and as directed by the Engineer-in-Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with a screwdriver and not hammered in. Recess shall be cut to the exact size and depth for the counter sinking of hinges. The fittings and fixtures shall be fixed in a workman like manner and any damages done either to fittings and fixtures or to the shutter frames etc. should be rectified by the contractor at his own cost.

Fittings shall be of Mild steel, Stainless steel, aluminium, brass or as specified. The fittings shall be well made, smooth, and free from sharp edges and corners, flaws and other defects.

Mild steel fittings shall be bright satin finish black stone nodized or copper oxidised (black finish), nickel chromium plated or as specified.

Brass fittings shall be finished bright satin finish or nickel chromium plated or copper oxidised or as specified.

Aluminium fittings shall be nodized to natural matt finish or dyed anodic coating less than grade AC 10 of IS: 1868

Stainless steel fittings shall be non-magnetic, rust & moisture proof, strong & sturdy. Pin of hinges shall also be of stainless steel.

c. **BUTT HINGES :** Brass and aluminium hinges shall be manufactured from the

extruded sections and shall be free from cracks and other defects. M.S. butt hinges shall be cranked and manufactured from M.S. sheets. All butt hinges shall conform to latest I.S. specifications butt hinges shall generally condorm to releval I.S viz IS 1341 (M.S.) IS : 205 (Cast brass & aluminium, IS : 362 (Parliament hinges); IS : 453 sprig higes, IS : 3818 (Piano higes) etc. The size of butt hinges shall be taken as the length of the hinge. Width of the hinge shall be measured from the centre line of hinge pin to end of flange.

d. **PARLIAMENTARY HINGES :** These shall be manufactured from extruded section for brass and aluminium and from M.S. sheets for iron oxidised and shall be free from cracks and other defects. The size of the parliamentary hinges shall be taken as the width between open flanges, while the depth shall be as specified.

e. PIANO HINGES :

These shall be generally conformed to I.S. 3818 and shall be made of either brass oxidised, aluminium nodized, iron oxidised (M.S.) or as specified. Piano hinges shall be fixed in the entire length of the cupboard shutters in a single piece. No joints shall be allowed.

f. **TOWER BOLTS :** These shall generally conform to IS 204 (Part II & I). They shall be well made and shall be free from defects.

The tower bolts shall be of the following types :

i. MS semi barrel tower bolt with ms sheet pressed barrel and G.I. bolt or with ms barrel and ms Sheet bolt.

ii. Oxidised brass barrel tower bolt with brass sheet barrel and rolled or drawn brass bolt.

iii. Anodised aluminium tower bolt with barrel and bolt of extruded sections of aluminium alloy.

In case of M.S. tower bolt plates and straps after assembly shall be firmly nodize or spot welded properly.

The knobs of brass tower bolts shall be cast and the bolt fixed into the knob firmly as per I.S. specifications. The tower bolt shall be finished to correct shape and pattern so as to have a smooth action. Wherever specified, aluminium barrel tower bolts shall be manufactured from extruded sections of barrel & bolts.

Knobs shall be properly screwed to the bolt and riveted at the back. The size of the tower bolt shall be taken as the length of barrel without top socket.

g. Door Letch :

This shall be of MS, cast brass or as specified shall have smooth sliding action. MS Latch shall be copper oxidised (black finish) or as specified. Brass Latch shall be finished bright, CP or oxidised or as specified

h. ALDROPS :

These shall be oxidised brass or nodized aluminium, iron oxidised or as specified and shall be capable of smooth sliding action and shall be as per relevant I.S. Brass sliding door bolt (aldrop) shall be made from rolled brass generally confirming to IS : 2681. M.S. sliding door bolt shall generally conform to I.S.281. The hasp shall be of cast brass and screwed to the bolt in a workman like manner. Alternatively the hasp and the bolt may be in one piece. Bolts shall be finished to shape and threaded with worth standard and provided with round brass washers and nuts of square or hexagonal shape. All components shall be smooth and polished. The leading dimensions of aldrop shall be as the length of the bolt and specified diameter.

i. DOOR HANDLES- BOW/PLATE HANDLES :

These should generally conform to IS : 208. Unless otherwise specified door handles shall be of 100 mm size & windows handles of 75 mm size. These shall be of cast brass of specified size, shape and pattern as approved by the Engineer-in-charge. All edges and corners shall be finished smooth and correct to shape and dimensions. Brass handles shall be finished bright, chromium plated or oxidised as specified. Anodised aluminium or iron oxidised (m.s.) handles shall be of specified size, shape and pattern. The size of the handle is taken as the inside grip of the handle. In case of iron oxidised handles, the same shall be manufactured from m.s. sheet pressed into oval section as per I.S.

j. MORTISE LOCK & LATCH :

This should generally conform to I.S. 2209. Handles shall conform to IS 4992.

Mortise lock with latches and a pair of level handles shall be 6 levers, with zinc alloy pressure die cast/brass or as specified body of approved quality, and shall be right or left handed as specified. The pair of handles shall be either brass chromium plated or nodized aluminium of approved shape and pattern or as specified. It shall be of the best Indian make of approved quality. The size of the lock shall be determined by its length. The lock for single leaf door shall have plain face and that for double leaf door a rebated face. Level handles with springs shall be mounted on plates and shall be of approved quality, nodized aluminium or as specified.

k. HYDRAULIC DOOR CLOSER :

This shall be generally conform to IS : 3564. Hydraulic door closer shall be of approved quality and make. The operation of the Hydraulic door closer shall be very smooth.

This should be of H.D.-66 for external/main doors and elegant - 63 for all internal doors. The overall height should not be more than 170 mm. for H.D.-66 and 160 mm. for elegant - 63, base shall be 110 x 60 mm. for H.D.-66 and 100 x 55 mm. for elegant - 63 weighing not less than 4.5 kg. for H.D.-66 and 4 Kg. for elegant - 63. Speed of the Hydraulic door closer shall be adjustable and latch closing also shall be adjustable type. Suspension and lubrication of door closer shall be in perfect line and level.

l. The contractor shall provide for all the incidentals required for fixing these fixtures and fittings such as cadmium plated screws etc. Fittings and fixtures shall be fixed securely in a workman like manner all as directed by the Engineer-in-charge. Any of the fixtures damaged during the fixing shall be removed and new one fixed in their

place and the surface of joinery made good where affected, at his own expense. Mortise plates shall be used over holes where the bolts enter in the wood work. Metal sockets shall be provided to all bolts where the shoot enter brick, stone, concrete etc. The incidental Fixtures like mortise plates, metal sockets, screws etc. shall not be paid for separately.

m. **MORTICE NIGHT LATCH :** This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS: 3847. It shall be cast or sheet brass, cast or sheet aluminium alloy or mild steel as specified and of approved make. These shall be bright finished or copper oxidised (black) finish as specified. Normal size of the latch shall be denoted by the length of the face over the body in millimetres.

n. **FLOOR DOOS STOPPER: The** floor door stopper shall conform to IS: 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidised or as specified. The size of door stopper shall be determined by the length of its plate. The body of the door stopper shall be cast in one piece. All parts of the door stopper shall be of good workmanship and finish and free from surface and casting defects. Aluminium stopper shall have anodic coating of not less than grade AC-10 of IS 1868.

o. **MODE OF MEASUREMENT AND RATE :** Unless otherwise specified, all fittings including all necessary accessories shall be measured in numbers and the rate shall include the cost of all materials including taxes, octroi, excise duty, if any, loading, unloading, transporting, cost of screws, bolts and other accessories and fixing the same complete.

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36 GLASS AND GLAZING :

a. SCOPE OF WORK :

The work covered by this specification include furnishing and fixing the glass panes to teak wood or steel doors and windows, strictly in accordance with these specifications and drawings.

b. MATERIALS :

i) **Glass :** The glass shall be special selected / selected ordinary quantity glass of M/s. Saint Gobain India or of equivalent manufacture, as specified. Toughened float glass of approved manufacturer shall be used wherever specified. The glass shall be free from bubbles, flaws specks, waves, air holes, distortion, scratches, cracks or other defects. The glasses in bulk quantities shall be brought to site in Makers original packings and Makers guarantee shall be produced if called for by the Engineer-in-charge. The glass shall be of required thickness as mentioned in the items of schedule of quantities and/or drawing or as directed by the Engineer-in-charge. The contractor shall submit the sample of the glass which he

proposes to use on the work and only such approved quality of glass shall be used in the works. The glass brought to site shall be protected against damages. Wherever frosted (obscure) glass is mentioned in the item of schedule of quantities and / or shown in drawings, the glass shall be of sand blown pattern and shall also be got approved from the Engineer-in-charge.

ii) **Beading :** The beading shall be of teak wood of superior quality timber in case of teak wood doors and windows and/or required sizes mentioned in the items of schedule of quantities and/or shown in drawing. In case of steel / Aluminium doors and windows, the beading shall be anodised aluminium beading of channel section as per sizes mentioned in the item and / or shown in the drawing. The junction of the beadings shall be mitre jointed.

iii) **Dimensions, Thickness and weight of the glass:** Unless otherwise specified, these shall be as per table given below. All panes shall have properly squared corner and straight edges

Normal	**Range of**	**Weight in kg /**
3.0 mm	2.8 to 3.2 mm	07.5
4.0 mm	3.8 to 4.2 mm	10.0
4.8 mm	4.6 to 5.1 mm	11.9
5.5 mm	5.2 to 5.8 mm	13.5
6.3 mm	6.0 to 6.6	15.5

c. WORKMANSHIP :

The glass shall be cut to the required sizes of panels where it is to be fitted, and it shall be so cut that it fits properly in the frames without rattling. Pre-measurement of each panel prior to the cutting of glass is essential.

The beading shall then be fixed to glass panes and screwed at close intervals not more than 10 cm. from each corner and the intermediate not more than 20 cm. apart. When the glass panes are fixed with aluminium beading having mitred joints, epoxy resin or silicon sealant shall be applied covering the area in contact between the glass panes and sash bars and also between glass panes and the beading. In case of louvers, all the exposed edges of the glass shall be ground properly.

All glass panes shall be fixed within the aluminium framing by use of CP brass or SS screws and the joints sealed with epoxy resin or silicon sealant to make the unit completely waterproof. Glazing or caulking compound around the perimeter of glass shall not be permitted. Fixed glass panes shall be supported by setting blocks. There shall be no whistling or rattling.

d. GENERAL :

After the inspection is over and permitted by the Engineer-in-charge, glass panes shall be cleaned off any labels, paints smears and spots and shall be washed from both the sides and all glazing left clear, perfect and free from rattling. The contractor shall provide all the scaffolding, tools and plants for fixing the glass panes at his own cost. In case of steel windows, any hardware if fixed in position, shall be

removed temporarily before fixing the glass panes and which shall be re-fixed back in position, all at the contractors cost.

e. MODE OF MEASUREMENT :

The rate for teak wood door/window shutters and/or steel door/window shall normally cover the cost of glass and glazing also, unless otherwise mentioned. In case the glazing is carried out as a separate item, the measurement shall be taken out to cut size of teak wood/steel door/window frames forming the sides of glass panes and area calculated to two places of decimal of a square meter.

The rate shall include the cost of supplying and fixing the glass panes, all materials, labour, transport, scaffolding etc.

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3 7 STEEL DOORS, WINDOWS AND VENTILATORS:

SCOPE OF WORK :

The work covered under these specifications consist of supplying steel windows and doors and ventilators, fixing, glazing etc. complete in strict accordance with the specifications and relevant detailed/shop drawings.

a. GENERAL :

The contractor shall submit 6 copies of shop drawing covering all types of work under this specification before manufacture. The drawing shall show all dimensions, details of construction, installation, relating to adjoining and related work etc.

b. MATERIAL :

Shutters, frames etc. as dimensioned in the drawing shall be fabricated from I.S. standard sections rolled . No glazing bars shall be provided unless otherwise shown in drawing. Glazing used will be clear sheet glass of special selected quality manufactured by Saint Gobain India or approved equivalent, unless otherwise specified. Steel sections shall be free from rolling or other defects. They shall be easily welded and punched and shall be cold straightened and shall conforming to latest I.S. 1038 - 1983. The anticorrosive shop coat of paint shall be given before the materials are brought to site.

c. COUPLING BARS FOR COMPOSITE DOORS,WINDOWS AND VENTILATORS :

All doors window, ventilators units shall be so constructed that those if required may be coupled together by means of the standard mullion and weathered transom bars and coupling pieces.

All steel hinges shall be projected steel hinges with non magnetic stainless steel pins and washers to permit complete ease in cleaning the glass and shall be welded or rivetted to the frame.

d. FABRICATION :

The frames shall be square and flat and shall be constructed of sections cut to length, mitred and welded at corners. All welding shall be electrical flash butt welding excepting for the welding of steel sheets for the shutters.

Sections shall be formed true to details with clean straight, sharply defined profiles and free from defects that may impair its durability. All works shall be accurately formed to the required dimensions, line and level. All joints shall be continuously reinforced, fitted and continuously welded at the edges. Surface along joints shall be ground to attain a smooth level surface even and flush with adjoining surfaces. All frames shall be properly reinforced for the attachment of hardware. The heads of frames for openings wider than 1.2 m. shall be reinforced to prevent sagging or deflection when installed.

e. INSTALLATION :

The doors, windows and ventilators brought to site shall be stacked up site down on wooden runner under cover. Fixing shall be done as per latest Indian Standard Specifications. The size of the prepared openings shall be checked first and these should be cleaned off all obstructions.

The doors/windows/ventilators shall not be forced into the walls but shall fixed into prepared openings in workmen like manner.

All joints between masonry/concrete and the metal shall be fully filled with approved mastic filler/putty in order to ensure water tightness. The joints shall be neatly pointed with matching cement and excess material shall be removed.

All brick jambs and sill holes shall be cut 50 mm. square and 100 mm. deep for fixing hold fasts. All concrete jambs and lintels, holes shall also be carefully drilled and if reinforcing steel is encountered, the length of the hold fasts may be decreased and existing surface made good to the original condition.

Any hard ware if fixed in position shall be removed before fixing the frames in the structural openings and moving parts shall be secured with wire or string during erection and while the building work is being completed to prevent damage to the part. Hardware shall be fixed as late as possible preferably just before the final coat of paint is applied. It shall be fitted in workmanlike manner so that it may not be marked and mutilated by hammers and screws and pins are not marked and mutilated by hammers and screwdrivers. It shall be tested for correct operations to the satisfaction of the Engineer-in-charge.

f. DETAILS OF COMPONENT PARTS :

i. **Doors :** Door shutters shall be hung on projecting hinges of 67 mm size and shall be fitted with mortise lock and two brass or bronze lever handles. In case of double leaf doors, the first closing leaf of double leaf doors shall also be provided with brass or bronze tower bolts concealed in the section at top and bottom. These shall be so constructed as not to work loose or drop by their own weight and necessary lugs, fittings, screws etc. shall be provided and fitted properly at site.

ii. **Windows :** Window shutters shall be hung on projecting hinges. One leaf of the hinges shall be welded into a slot in the outer frame and the other leaf of the hinges riveted to the opening shutters. Hinges may be of the friction type in which case the window shall not be fitted with peg stay. In case of non-friction projecting hinges, a brass or bronze three holes peg stays 300 mm. long with pegs and brackets, welded or rivetted to the frame shall also be provided. Handles shall be of brass or bronze and shall be of brass or bronze, and shall be mounted on a mild steel handle plate welded to the shutter in such a way that it should be fixed after the shutter is glazed. The handles shall have a two point nose which shall engage with brass, bronze or aluminium alloy as specified, striking plate, on the fixed frame so that it can hold the shutters in a slightly openable as well in a fast position.

iii. **VENTILATORS : a) Top hung ventilators :** These shall be fixed with plain hinges, riveted to the fixed frames or welded to it after cutting a slot in it. A peg stay 300 mm. long of brass or bronze with three holes, as in case of windows shall be provided.

The locking bracket shall either be fitted to the fixed frame or to the ventilators.

b) **Centre Hung Ventilators :** These shall be hung on two pairs of brass of lead/tin/bronze cup pivots, riveted to the inner and outer frame of the ventilators to permit these to swing through an angle of approximately 85 deg. The opening portion of the ventilators shall be so balanced that it remains open at any desired angle under normal weather condition.

A bronze or brass spring catch shall be provided at the top centre of the ventilator. A brass cord pully wheel in a mild steel or malleable iron brackets, shall be fitted with screws or welded at the sill and a cord eye shall be fixed to inner frame of ventilators to facilitate opening of ventilators.

iv. **Composite Units :** Composite units consist of a combination of two or more units of doors, windows, ventilators etc. as the case may be. The different units shall be coupled by using coupling sections. The coupling sections shall be made from M.S. sheet 3.15 mm. in thickness and 56 mm. wide as per I.S. 1038-1957 para 5.2 and these shall be fixed with bolts and nuts.

Wherever the ventilators, windows and doors shall have coupling section, mastic cement shall be applied between the junctions to make the joints watertight.

To calculate height or width of composite units, add 2.5 cm. for each mullion or transom coupling bar for each unit.

g. **FINISHING :** All steel surfaces shall be thoroughly cleaned of rust, scale and dirt by pickling and marking. A shop priming coat of superior quality red oxide or equivalent shall then be given before despatch. Alternatively, where so specified, the steel surfaces shall be treated for rust proofing by the hot dip zinc spray or electro galvanising process, having a coating of not less than 60 microns thickness or as specified. Zinc spray articles shall be given one coat of priming coat of superior quality red oxide or equivalent.

Final finishing with two coats of synthetic enamel/flat oil paint of approved make and shade shall be given after the doors,windows and ventilators are erected/fixed in final position. The rate shall be inclusive of final finishing coats including the priming coat.

In case of galvanised doors, windows and sashes, their surfaces shall be treated with copper acetate solution or other approved mordant solution to ensure proper adherence of paint, unless the galvanised surface has weathered adequately at the time of final painting.

Non-ferrous parts and working parts such as handle stays, catches, handle pins, hinge pins etc. shall not be painted.

h. **GLASS AND GLAZING :** Specifications for glazing given in this book under chapter Glass and Glazing, shall also be applicable for steel doors / windows / ventilators.

i. **MODE OF MEASUREMENT :** The mode of measurements for steel doors, windows and ventilators for complete item of supply and fixing in position shall be on area basis calculated in sqm. correct to two places of decimal. The height and width of members shall be measured outer to outer edge of the members correct to 1 mm.

The rate for steel door, window and ventilator shall include cost of all fittings, materials, hold fasts, glazing, painting, labour etc.

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38 ROLLING SHUTTERS :

a. SCOPE OF WORK & GENERAL :

Item refers to supplying and fixing rolling shutters of size and type as specified in the description of item.

b. MATERIALS :

Rolling shutters complete with accessories shall be of approved quality and as specified. These shall be suitable for fixing in position as specified i.e. outside or inside; on or below lintel or between jambs of the opening. Rolling shutter shall be hand/gear operated as specified in the item of schedule of quantities. For hand operated shutters, it shall be push and pull type. For gear operated shutters, it shall be provided with reduction gear operated by mechanical device with chain, crank, shaft and handle. The shutter shall consist of 80 mm. wide MS laths 1.25 mm thick or gauge as specified of best quality mild steel sheet machine rolled. Laths shall be

inter-locked together throughout their entire length and jointed together at the end with end locks. These shall be mounted on specially designed pipe shaft. The spring shall be of best quality and shall be manufactured from the tested tensile spring steel wire or strip of adequate strength to balance the shutter in all positions. The spring, pipe shaft etc. shall be supported on strong mild steel or malleable cast iron brackets. Both the side guides and bottom rails shall be jointless and of single piece of pressed steel of minimum 16 gauge thickness. The top cover of shaft, spring etc. shall be of the same materials as that of lath. No extra payment shall be made for the hood, brackets etc. to cover the shaft etc. The reduction gear arrangement operated by the mechanical device shall be of the best quality and shall be easy in operation.

c. FIXING :

Brackets shall be fixed on the lintel/beam or under the lintel/beam as specified in item with rawl plugs and screws, bolts, washers etc. The shaft along with the spring shall then be fixed on the brackets. The lath portion (shutters) shall be laid on ground and the side guide channels shall be bound with it. The shutter shall then be placed in position. The side guide channels shall be fixed to the wall through the plates welded to the guides. These plates and brackets shall be fixed by means of steel screws, bolts and rawl plugs drilled into the wall. The plates and screws, bolts shall be concealed in plaster to make their locations invisible. Fixing shall be done accurately in a workman like manner that the operation of the shutter is easy and smooth. All grout holes and damages on the wall while fixing of shutters shall be made good by the contractor at no extra cost . The contractor shall ensure smooth and easy working of shutters. All the members of the rolling shutter shall be thoroughly cleaned off dust, scales, rust etc. and shall be given approved priming coat of red oxide paint before fixing the shutter in position and then shall be painted with two coats of flat/synthetic enamel paint of approved quality and shade.

d. MODE OF MEASUREMENT :

The area of rolling shutters shall be measured in square metre correct upto two places of decimal. Width and height shall be taken for net opening correct to a centimeter.

e. RATE :

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

* * *

39 M. S. GRILLS / RAILINGS :

a. GENERAL :

The contractor shall submit 6 copies of shop drawings covering all types of work under this specifications before manufacture. The drawing shall show all dimensions, details of construction, installation relating to the adjoining work.

b. MATERIALS :

All structural steel shall conform to I.S. 226 sections for grills and shall be free from loose mill scales, rusts, pittings or any other defects affecting its strength and durability.

c. FABRICATION :

The grill shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in best workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape. The joints shall be filled to remove excess stay after welding. Screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings, devices shall be of steel and shall be provided by the contractor.

Manufactured M.S. grills then be fixed in between the posts, balusters, M.S. frame work etc. to correct alingnment. Any undulations, bends etc.found shall be rectified by the contractor at his own cost. The complete assembly of grill/railing so fixed shall be firm and there shall not be any lateral movements.

d. SAMPLES :

Samples of grill and railings shall be submitted for approval of the Engineer-in-Charge and to be got approved before taking up for mass fabrication.

e. INSTALLATION :

The approved grills shall be fixed in position where specified and shown in drawings including in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. caused during fixing the grills shall be made good by grouting with cement mortar/packing/repairing properly at the contractors cost.

f. PAINTING :

Painting shall be done as per the specifications specified under painting.

g. MODE OF MEASUREMENT :

Actual area of M.S. grill manufactured and fixed in position shall only be measured in square metre for payment. All measurements shall be taken to two places of decimal of a metre and area shall be calculated to second place of decimals of a square metre.

The rate is to include the cost of all materials, labour, transporting, fabricating, installing, scaffolding if necessary, grouting etc. complete.

h. FINISHING/PAINTING/POLISHING FOR RAILING :

Teak wood hand rail shall be polished with wax polish/ french polish/solignum with two or more coats over one coat of wood primer or painted with two coats of synthetic enamel paint/flat oil paint of approved make and shade over one coat of approved primer. M.S. grills, balusters etc. also to be painted as per specifications specified under painting/polishing.

i. MODE OF MEASUREMENTS (HAND RAILS) :

Hand railing shall be measured for payment in running metre. The length shall be measured along the top centre line of the hand rail and shall be measured between ends of balusters, newels, posts as the case may be upto two places of decimals of a metre. Rate shall include fabrication, leaving suitable pockets, grouting the same, providing and fixing suitable teak wood plugs, fixing, all labour, materials, transport, painting/polishing, finishing and scaffolding if necessary.

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40 ALUMINIUM ENTRANCE DOORS, WALL SPANS, GLAZING ETC.

a. SCOPE OF WORK :

The scope of work in the present tender item includes fabrication, supply and installation of white anodised matt finished aluminium entrance doors, glazing etc. strictly in accordance with these specifications and relevant detailed approved shop drawings.

b. GENERAL :

The material, fabrication and hardware shall conform to the IS 1948. The contractor shall submit 6 copies of shops drawings covering all type/details of work as generally shown in Architectural drawing and envisaged under these specifications before manufacture. The drawing shall show all dimensions, details of construction, installation of fixtures and relation to adjoining and related works. No fabrication work shall be undertaken prior to obtaining approval of the shop drawings from the Engineer-in-Charge. The tenderer shall intimate at the time of tendering, the type of sections he proposes to use on the works.

c. MATERIALS :

Aluminium alloy for extruded sections for the above work shall correspond to I.S. 733 & 737 specifications or any further revision thereof(extruded sections shall conform to I.S. Designation HE 9- WP. Hollow sections shall conform to I.S. Designation HV9-WP) and shall be anodised before incorporating in the work. Anodic coating shall conform to IS 1868. The frame work, stiles, mullions, beadings, transoms and handles etc. shall be of aluminium anodised sections as shown in detailed approved drawings. All aluminium sections shall be of INDAL or other equivalent make as per drawing. The contractors can also propose nearest alternative sections they manufacture/posses without changing the elevation, structural stability & functional requirement. E.I.C reserves the right to accept the alternative section or otherwise. The sections shall be structurally suitable to withstand all the loads, the members have to sustain. Counter sunk screws, nuts, bolts, washers, rivets and other miscellaneous fastenings devices shall be of approved brass cadmium plated or stainless as specified in the approved drawing. Each door leaf shall be prepared to receive glazed panel of required thickness. Glazing shall be done with neoprene dry set glazing gasket (of best quality and approved make) with snap-in-bevelled white anodised matt finish aluminium metal glazing stops inside and outside. All doors shall have off- set pivots, double action (180^0 minimum swing) floor springs with oil check boxes of approved manufacture.

All doors shall have 4 lever concealed brass body mortise lock without handles as per manufacturers design, with concealed flush C.P. brass tower bolts provided at suitable locations. All doors shall have push plates of design shown in the approved drawing as described in the schedule of quantities. All entrances shall be without thresholds. All aluminium surfaces in contact with masonry or concrete shall be given a thick coat of bitumastic paint. After fabrication, aluminium sections shall be protected from construction hazards that may damage their appearance or finish. All exposed surfaces of aluminium door entrance shall be protected by masking tape during transshipment and erection. All sections and hardware shall have anodic film and cover a minimum thickness of 0.015 mm.

d. FABRICATION :

The frames shall be manufactured square and flat, the corners of the frame being fabricated to true right angle. All the fixed, sliding and opening frames shall be constructed of sections which have been cut to length, mitred, welded and mechanically fixed at the corners. Where hollow sections are used with welded joints, argon-arc welding or flash butt welding shall be employed (Gas welding or brazing not to be done). In case welded joints are used, anodising shall be done after fabrication as a whole. All welding shall be on unexposed sides in order to prevent pitting/discolouration of other surface imperfections after fixing etc. Necessary allowance shall be made while manufacturing the aluminium door entrances, wall spans and glazing for receiving plaster. No field fabrication of frames is permitted. A thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate shall be applied on the finished sections of the aluminium work by the contractor to protect the surfaces from wet cement, lime, dirts, dust etc. during the construction activities. The size for door, window or ventilator frames shall not vary by more than (+/-) 1.5 mm.

e. HARDWARE :

All cut outs, recesses, mortising or milling and operations required for fixing the hardware shall be accurately made reinforced with packing plate as required to ensure adequate strength of the connection. All the hardware accessories shall be of best approved type and of anodised finish same as for the frames and other sections. Each lock shall be supplied with two stainless steel keys and each key shall be with number stamped thereon according to the number on doors so installed. All hardware shall be free from defects, which may affect the appearance and serviceability. All hardware shall be fixed after obtaining the prior approval of the Engineer-in-Charge. Approved samples of hardware shall be kept in the custody of the Engineer-in-Charge. Working and moving parts of locksets shall be accurately fitted to smooth, close bearings and shall be free from rattle. The floor springs shall be of heavy-duty type and should allow door operation smoothly and shall conform to IS 6315. The contractor shall furnish a guarantee for all finishing and quality of hardware covered under this section and which shall remain free from defects of any kind, either materials and/or workmanship for a period of one year (unless otherwise specified) from the date of completion/handing over of work. The contractor shall repair or replace any and all defective work and damage caused, at any time or times during that period within 3 days from the written notice. This shall be done without any extra cost and to the complete satisfaction of the Engineer-in-Charge.

f. FIXING :

Fixing and glazing of doors, windows and ventilators shall be conforming to IS 1081, unless otherwise specified. The frames shall be accurately fixed in the flooring / brick masonry or R.C.C. works. The fixing of the frame shall be done with cadmium plated brass counter sunk screws driven on to the teak wood rough ground, or fixed to the wall with hold fasts as directed by the Engineer-in-charge, and as shown in approved drawings. All aluminium works shall be fixed in position as per relevant Indian Standard Specifications and code of practice for fixing and glazing of aluminium work. Joints between metal and masonry shall be fully caulked with mastic / polysulphide compound in order to ensure water tight joints as directed by the Engineer-in-Charge. Joints shall be neatly painted with matching cement and excess materials shall be removed. Fixing of aluminium door entrances, hardware etc. shall be done in best workmanship like manner true to line, level, plane, plumb etc. and all as directed by the Engineer-in-Charge. Breaking of floor for providing floor springs and restoration of the floor finishes to the original specification and finishes and minor additions and alterations to the openings shall be deemed to have been included in the quoted rates.

g. GLASS AND GLAZING :

i. **Glass :** The glass shall be of selected quality/special selected quality of M/s. Saint Gobain or equivalent manufacture, as specified under the chapter GLASS AND GLAZING.

ii. **Glazing Clips/Beading :** The glazing clips/beading where specified in drawings for aluminium/steel doors and windows shall be anodised aluminium beading of channel section or as specified & as per sizes mentioned in the item and/or shown in the drawing.

The junction of the beadings shall be mitre jointed. Holes for glazing clips shall be drilled prior to fabrication and shall not be done at any later stage.

iii. The glass shall be cut to the required sizes of panels where it is to be fitted and it shall be so cut that it fits properly in the frames without rattling. Premeasurement of each panel prior to the cutting of glass is essential.

The clips/beading shall then be fixed to glass panes and screwed at close intervals not more than 10 cm. from each corner and the intermediate not more than 20 cm. apart. When glass panes are fixed with wooden beadings having mitred joints or aluminium beading, a thin layer of glaziers putty shall be applied covering the area in contact between the glass and sash-bars and beadings. In case of louvers all the exposed edges of the glass shall be ground properly.

iv. **Glazing :** The glass panes shall be fixed to the frame as mentioned above with approved Neoprene dry set glazing gasket (of best quality and approved make) with snap-in-bevelled white anodised matt finished aluminium metal

glazing stops inside and outside. In the fixed side and transom light, the thickness of glass or panel shall be accommodated by the screw down glazing stops. The glass panels shall be fixed firmly and truly parallel to the plane of frames. All damages or breakages during glazing shall be made good at the contractors own cost till the work is properly taken over by the Engineer-in-Charge. All wall spans glazing and entrances, fixed glazing etc. shall be tested for water tightness. Any leakage found during testing, it is the responsibility of the contractor to rectify the same without any extra claim.

v. **General :** After the inspection is over and permitted by the Engineer-in-Charge, the glass panes shall be cleaned off any labels, paint smears and spots and shall be washed from both the side and all glazing left clear, perfect and free from rattling. The contractor shall provide all the scaffolding, tools and plants for fixing the glass panes at his own cost. In case of aluminium/steel doors/windows any hardware if fixed in position shall be removed temporarily before fixing the glass panes and which shall be re-fixed back in position all at the contractors cost.

h. MODE OF MEASUREMENT :

a) **Aluminium work:** The measurement of aluminium sections shall be taken only after the frames along with shutters are fixed in its final finished position in line, level and plumb. Length of each extruded section used for fabrication shall be measured **outer to outer of cut length** correct upto 1 mm

b) The weight of material used shall be calculated on the basis of actual weight of extruded sections used for fabrication and shall be compared with the weights given in the catalogue of the approved manufacturer subject to the condition that the variation in actual weight should not exceed (+ / -) 10% than the approved catalogue weights. The payment shall be made for the actual weight of the extruded section **after anodising.** The final weight shall be calculated in kgs upto two places of decimal.

c) **Glazing work:** The length and width of opening for glazing inserts shall be measured correct to a centimetre and area for payment shall be calculated in square metre nearest to 0.01 sqm.

i. RATE :

Unless otherwise specified, Fittings and fixtures such as window handles, hinges, peg stays, friction stays, concealed window lock, cleat angles, stiffener plates etc. shall not be measured for payment and rate quoted shall include cost of all such fittings, accessories and hardware. However, door handles, mortise lock, dead lock, door closer, floor springs, concealed door tower bolts shall be measured separately as specified in the item and paid for.

The rate quoted shall include all taxes, duties etc. tools, plants, labour involved in all the operations described above, fixing in final position including submitting shop drawings etc. and all incidentals to the job involved.

j. TESTING :

Aluminium sections shall be tested for its unit weight, anodic coating etc. as per relevant IS codes.

k. GUARANTEE :

All materials used in above work shall be **guaranteed for one year** (unless otherwise specified) from the date of handing over the work. Any defect found in the guarantee period shall be replaced/repaired to original condition/position entirely at the contractors cost.

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41 ALUMINIUM WINDOWS, VENTILATORS, COMPOSITE UNIT ETC. :

a. SCOPE OF WORK :

The scope of work in the tender item includes fabrication, supply and installation of anodised finished aluminium windows, ventilators, composite units, glazing etc. strictly in accordance with these specifications and relevant detailed approved shop drawings.

b. GENERAL :

The material, fabrication and hardware shall conform to IS 1948 & 1949. The contractor shall submit six copies of shop drawings covering all types/details of work as generally shown in Architectural drawing and envisaged under these specifications before manufacture. The drawing shall show all dimensions, details of construction, installation, fixtures and relation to adjoining and related works. No fabrication work shall be under- taken prior to the approval of the shop drgs. from the Engineer-in-Charge. The tenderer shall intimate at the time of tendering, the types of sections he proposes to use on the works.

c. MATERIALS :

The aluminium alloy used in the manufacture for extruded window section shall correspond to I.S. 733 (or any further revision thereof). Extruded sections shall conform to I.S. designation HE9-WP and Hollow sections shall conform to I.S. Designation HV9-WP. The frame work, stiles, mullions, beadings, transoms, hinges, pegstays, handles etc. shall be of aluminium anodised sections as shown in the detailed drawings. All sections and hardware shall have minimum anodic film thickness of 0.015 mm. All sections shall be of JINDAL or other equivalent make as per drg. The contractor can also propose nearest alternative sections they manufacture/posses without changing the elevations and functional requirements.

E.I.C reserves the right to accept the alternative sections or otherwise. The sections shall be structurally suitable to withstand all the load, the members have to sustain. Countersunk screws, nuts, bolts, washers, rivets and other miscellaneous fastening devices shall be of approved cadmium plated or stainless steel as specified in the approved drawings.

d. FABRICATION :

The frames shall be manufactured square and flat. The corners of the frames shall be fabricated to true right angles. All the fixed, sliding, openable frames shall be constructed from sections which have been cut to length, mitred and mechanically jointed or welded at the corners. Where hollow sections are used with welded joints, argon arc welding or flash butt welding shall be employed (Gas welding or brazing not to be done). Sub-dividing bars of units shall be tennoned and rivetted into the frames. In case welded joints are used, all welding shall be on unexposed sides in order to prevent pitting, discolouration and other surface imperfections after finishing. The dimensions shown in the drawing are overall heights and widths to the outside of frames of aluminium windows. The side hung shutters shall have projected friction type hinges of aluminium alloy. Concealed projected hinges having structural stability and of good quality will also be considered only after the inspection of the sample submitted by the tenderer. The necessary pegstays, handles, window fasteners etc. shall be of aluminium. The handle shall be mounted on a handle plate rivetted to the opening frame. The pegstays shall be 300 mm. long or as required complete with peg and locking bracket and shall have holes for keeping the shutter open in three different positions. No field fabrication of frames is permitted. The complete fabricated assembly shall be anodised in approved satin finish with minimum film thickness of 0.0 15 mm. for the entire surface. A thick layer of clear transparent lacquer based on methacrylate or cellulose butyrate shall be applied on the finished sections of the aluminium windows etc. by the supplier to protect the surfaces from wet cement, lime, dirt, dust etc. during the installation. This lacquer coating shall be removed after installation is complete, if approved by the Engineer-in-Charge and all sections of the windows shall be protected by P.V.C. film covering.

e. HARDWARE :

All cut outs, recesses, mortising or milling and operations required for fixing the hardware shall be accurately made, reinforced with packing plate as required to ensure adequate strength of the connection. All the hardware, accessories shall be of best approved type and of anodised finish same as for the frame and other sections. All hardware shall be free from defects which may affect the appearance and serviceability. All hardware shall be fixed after obtaining the prior approval of the Engineer-in-Charge. Approved samples of hardware shall be kept in the custody of Engineer-in-Charge.

f. FIXING :

The window frames shall be accurately fixed in the brick masonry or R.C.C. work. The fixing of the frame shall be done with cadmium plated brass counter sunk screws driven on the teak wood rough grounds if required or fixed to the wall with

holdfasts. All aluminium windows shall be fixed in position as per I.S. 1081-1960 (or any revision thereof): Code of practice for fixing and glazing of aluminium windows. All joints between metal and masonry/rough ground wooden frame shall be fully caulked with mastic or polysulphide compound in order to ensure water tight joints. Joints shall be neatly painted with matching cement and excess materials shall be removed. Hardware shall be fixed in workman like manner all as directed by the Engineer-in-Charge.

g. SAMPLES :

The samples of different windows shall be submitted to the Engineer-in-charge, for approval.

h. GLAZING :

The glazing shall be of Indian make plain sheet/frosted figured glass of special selected quality and size as mentioned in item description and drawings and shall be of M/S. Saint Gobain or equivalent manufacture. The specifications specified here-in-before shall hold good as far as applicable.

i. MODE OF MEASUREMENT :

Similar to as described under chapter "Aluminium Windows, Ventilators, Composite Unit Etc."

j. GUARANTEE :

All materials and workmanship in above work shall be guaranteed for a period of one year (unless otherwise specified) from the date of handing over the work. Unqualified performance guarantee for smooth operation of the windows, doors, wall spans and precautionary measures against leakages etc. shall be furnished by the contractor on stamped paper, if so specified in schedule of quantities. Any defect found during the guarantee period shall be replaced/made good to the original conditions/positions entirely at the cost of the contractor.

k. TESTING :

All windows shall be tested for water tightness. Any leakage found during testing shall be rectified by the contractor without any extra charge.

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42. ALUMINIUM CURTAIN WALL SYSTEM

42.1. *General*

1) Aluminium Curtain Wall System shall be designed for the following effects:

(a) Permanent Deformation, thermal expansion.

(b) Wind and seismic load

(c) Air and water infilteration or leakage.

(d) Lateral deflection per floor height

2) Unless otherwise specified the design of the system shall be prepared by the specialized firm for executing such works and submitted to the EIC for approval after detailed scrutiny and checking design calculations and drawings.

3) The work shall bear five years guarantee. It will be obligatory on the part of the contractor to execute the work systematically and conduct the necessary mock-up unit tests, before taking up the work to the satisfaction of EIC.

42.2. ***Specification for Materials used for Curtain Wal***

1	**Glazing**	Glazing work shall be as specified in the description of the item and / or as described under the chapter Glass & Glazing of this book.
2	**Framing system**	Aluminium anodized extruded sections manufactured by reputed approved manufacturers, for all types of members like brackets, mullions, transom etc.
3	**Sealant**	As specified in the item or silicon sealant
4	**Insulation**	50 mm thick glass wool of minimum density 48 kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 micron on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion
5	**Heat Reflective Toughened Glass**	(a) St. Gobain - Reflectosolar as specified. (b) Glaverbel / Glavermass - Super Siliver. (c) Visteon Ford Brown or Grey Colour of any shade approved by the Engineer-in-Charge.

42.3. Aluminium Alloy Extruded Sections: Extruded sections to be used for fabrication of framing system for curtain walls shall be manufactured and supplied by approved reputed companies. In absence of specific extruded section, sections available conforming to BIS specification, manufactured by approved reputed companies, shall be used in the works. Dimensions and weights of the sections shall be as per approved drawings.

42.4. Components, General specifications, Glazing, Panelling etc. for Curtain Wall System: These shall be generally as per relevant Chapters in this book.

42.5. Scope of Work

42.5.1. Preliminary Requirements

i) The contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system, all in conformity with the drawings and approval of the Engineer-in-Charge.

ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawings,

iii) **The curtain wall system shall also include the following activities :**

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

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

(c) All thermal insulation associated with the system.

(d) All fire protection associated with the system.

(e) All copings and closure and metal cladding to complete the system.

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

(g) Isolation of dissimilar metals and moving parts,

(h) Anticorrosive treatment on all metals used in the system,

(i) Polyester powder coating aluminium sections,

(iv) The contractor shall also be responsible for providing the following :

(a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.

(b) Mock-ups, samples and test units.

(c) Performance testing of the curtain wall framing and glazing assembly.

(d) Co-ordination with the work of other trade.

(e) Insulation with glass wool 48 kg/cum at spandrels area.

(f) Protection.

(g) All final exterior and interior cleaning and finishing of the curtain wall system.

(h) As built record drawings and photographs.

(i) Guarantees and warranties.

(j) All hoisting, scaffolding, staging and temporary services.

(k) Conceptualising and design of a suitable maintenance system for curtain glazing,

(v) The water tightness and structural stability of the whole curtain wall system shall be the prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good all at the risk and cost of the contractor.

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

42.5.2. Design Requirements

(i) Curtain wall shall comply with all government codes and regulations, building bye-laws, if any.

(j) All curtain walling, individual aluminium and glass components and all completed work shall be designed and erected to comply with the following requirements.

42.5.2.1. Basic requirement: The basic design and architectural requirements shall consist of the size of window, net glass area, ventilator, configuration of windows and spandrels to be retained. However the contractor may propose alternatives on the construction details for approval of the Engineer-in-Charge, provided that all basic functional and architectural requirements are fulfilled.

42.5.2.2. Quality Consideration and other Activities

(j) The contractor while submitting the detailed design calculations should submit the folowing information on the quality of materials to be used and other aspects as detailed below:

(1) Metal quality, finishes and thickness

(2) Glass quality, coating and thickness and proposed manufacturer's brand names.

(3) Aluminium extruded sections including mullions and transoms together with structural calculations and proposed manufacturer's brand name and also the name of agency proposed for fabrication work.

(4) Arrangement and jointing of components.

(5) Field connections especially mullion to mullion and transom to mullion.

(6) Fixing and anchorage system of typical wall unit together with structural calculations.

(7) Drainage system and provision in respect of water leakage in the curtain wall system.

(8) Provisions for thermal movements.

(9) Sealant and sealing methods.

(10)Glazing Method

(11)Wind load and seismic load and any other specific load considered in the design

(ii) Design concept over lighting protection link-up system of the curtain wall for connection and incorporation into the lighting conductor system of the building (Lighting conductor system of the building shall be done by other approved specialized agency).

(iii)The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

42.5.2.3. ***Tolerances:*** Any parts of the curtain wall, when completed, shall be within the following tolerances:

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

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

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

42.5.2.4. ***Samples :*** The contractor shall also submit samples of aluminium extruded sections; mullion and transom sections in lengths of 300 mm with the same finish and workmanship as per the tender proposals and 300 mm x 300 mm samples of glass for approval of the EIC. (samples to include exposed screws and other exposed securing devices if any).

42.5.2.5. ***Ancilary Requirements to be fulfiled by the contractor***

(i) The contractor / approved specialized agency shall submit a maintenance manual for the curtain wall system inclusive of all metal parts, glass and finish etc.

(ii) During detailed design scrutiny and also during the actual execution of the work any additions and extra provisions that will have to be made as per theoretical requirements or site conditions shall be implemented and executed by the contractor at his own cost, without claiming any thing extra under any circumstances.

42.6. Execution of work –

42.6.1. Performance Testing - General Requirements

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

ii) After the approval of structural calculations and the drawing for construction of the curtain wall, one test unit for performance testing of the curtain wall shall be constructed by the contractor at an independent laboratory or at a laboratory approved by the Engineer-in-Charge.

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

iv) The contractor shall submit to the Engineer-in-Charge the test procedures to be adopted, test schedule and location for testing before the work of actual testing is taken up.

v) Prior to the fabrication of test units, the contractor shall submit shop drawings and design calculations of the test unit for approval of the Engineer-in-Charge.

vi) The contractor shall not start the work of erection of curtain wall on site till the approval for the successful completion of the mock up test and clear instruction in writing to start the work is received from the Engineer-in-Charge.

vii) The decision of the Engineer-in-charge in respect of the procedure to be adopted, in conducting the mock-up test and the judgment over the net results, shall be final and binding on the contractor.

42.6.2. *Test of Wind Pressure*

(i) The equivalent load of wind pressure or wind suction shall be given to the test unit as increasing or decreasing the inside pressure in the "pressure chamber" at which the test unit is fixed.

(ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.

(iii) The variation of dynamic pressure shall be of any approximate sine curve line.

(iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above.

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

(vi) **The deflection on the main structural parts in this condition shall not exceed :**

(1) 1/175 of the span between supports or 20 mm, whichever is less for

vertical elements.

(2) 1/250 of the span between supports for horizontal elements.

(3) The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.

42.6.3. *Test of Lateral Deflection per floor height*

(i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

(ii) The deflection of every ± 2.5 mm shall be increased up to ± 13 mm on the test unit (static deflection test)

(iii) The dynamic deflection shall be applied up to ± 13 mm.

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

(v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the damage shall be observed.

(vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.

42.6.4. *Water-tightness Test*

(i) Water shall be sprinkled to the Test Unit' under wind pressure.

(ii) Pressure shall not be applied to the test unit.

(iii) The volume of the sprinkling water in one minute shall be 5 litres per sqm minimum.

(iv) All water leakage and drainage system at the joint and the openable sash of the curtain wall system shall be observed from the outside of the chamber.

(v) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.

(vi) Water leakage shall not be observed inside at all parts of the test unit during first water-tightness test.

(1) Install the test unit.

(2) Hold first water-tightness test.

(3) Hold test of wind pressure as described above.

(4) Hold second water-tightness test.

(5) Lateral deflection test.

42.6.5. ***Test Report:*** The contractor shall submit five copies of test report to the Engineer-in-charge.

42.6.6. ***Cost of Performance Test***

(i) The contractor shall allow in his tender for the cost of the performance testing and fabrication, erection, corrections to and demolition of the test units including any special provision required in the testing laboratory for the tests mentioned above.

(ii) The contractor shall allow for amendments and adjustments to the mock-up unit as instructed and required by the Engineer-in-Charge / Architect or the consultant.

(iii) If the mock-up test unit fails to pass the initial testing, the contractor shall make the necessary corrections to the test unit and shall get the test unit retested by the testing laboratory until it passes the test.

(iv) Cost of corrections to the test unit and the cost of retesting shall be borne by the contractor.

(v) The contractor shall be allowed six calendar months time after the work is awarded to set up the test unit and conduct the required test as described above to the satisfaction of the Engineer-in-charge.

(vi) In case the contractor fails to conduct the necessary tests as described above or fails to meet the required test results, without any genuine cause within the allotted period of six months, the Engineer-in-charge shall be free to rescind the contract with all costs including the forfeiture of E.M.D. and any other securities deposited by the contractor under the condition of contract.

42.6.7. ***Record of Test and Drawings***

(i) The testing laboratory shall keep the approved copy of the shop drawing and calculations of the test unit at testing laboratory during testing of test unit.

(ii) The testing laboratory shall accurately and nearly record on the above mentioned shop drawings all changes, revisions, modifications etc. made to test unit, which shall become the record drawing.

(iii) On completion of testing and after approval of the test reports the testing laboratory shall submit the final record drawings to the Engineer-in-charge.

42.6.8. ***Fabrication and Erection***

(i) Frames shall be square and flat, both the fixed and openable frames shall be constructed of sections, which have been cut to length, mitred and mechanically jointed at the corners, Sub-dividing bar of units shall be tenoned and riveted into frames.

All frames shall have corners welded to true right angles. For jointing hollow sections flash butt welding, argon arc welding or mechanical jointing by inserts

shall be used. (Gas welding or brazing shall not be done). Concealed screws shall be used for joining the sub-units.

(ii) The grid for the curtain wall system shall be fabricated carefully with aluminium extruded sections like mullions and transom in the exactly same pattern as per the final drawings with amendments if any received from the laboratory after conducting the mock-up unit test.

(iii) The sizes of different members of the curtain wall system shall be exactly as adopted for the mock-up unit tests and the grid shall be fixed to the building member as shown in the drawing, received after conducting the mock-up unit test.

(iv) Care should be taken to see that any gap between the frame and support and the frame **itself is sealed with silicon sealant.**

(v) Finish of grid frame shall be either anodized, organic coating, backed enamel finish or as specified in the item of work, no visual variation in anodizing / colour shall be accepted.

(vi) Care shall be taken to see that the curtain wall system is not deformed, damaged during erection and it shall be protected from direct contact with wet or intermittent wet cement concrete mortar etc.

42.7. *Representative of the contractor*

Full time attendance of a qualified civil engineer with sufficient experience in construction of curtain wall system shall be provided for erection of test unit, all testing and later on actual construction.

42.8. *Performance Guarantee*

The contractor shall provide a performance guarantee as indicated in the Schedule of Quantities for a period of five years, to provide for expenses to cover the risk and cost of rectification of defect, noticed during the five years guarantee period. Guarantee period shall start from the date of completion and handing over of the project.

42.9. *Measurements*

(i) The breadth and the height of the finished work including the openable windows shall be measured in metres and cm and the net quantity for payment shall be calculated in sqm up to two places of decimal.

(ii) The area to be considered for measurement shall be the net area of the exterior face of the curtain wall as fixed including the openable windows, if any, as part of the curtain wall.

42.10. *Rate*

The rate shall include the cost of all operations described above including the cost of materials, labour, design, shop drawings, erection and testing, mock-up test units,

fabrication, erection, finishing, scaffolding, undertaking performance guarantee etc.. No other claims of any kind pertaining to this work shall be entertained.

* * *

43. STRUCTURAL GLAZING

l. Specification for Materials to be used In Structural Glazing

This shall be same as described for Aluminium Curtain Wall System.

m. Specification for Materials to be used In Structural Glazing

Aluminium extruded sections shall be from approved and reputed / renowned manufacturer. In absence of specific extruded section, sections available conforming to BIS specification, manufactured by approved reputed companies, shall be used in the works.

n. ***General Specification and Tolerances for Aluminium Extrusions*** Dimensions and weights of the sections shall be as per approved drawings.

Circumscribing Circle Diameter (CCD)

i) The product range shall be broadly as categorized below;

a) For solids upto 190mm.

b) For hollows upto 135mm

ii) Sections with higher CCD, if required, shall be produced from reputed / renowned manufacturer as approved by the Engineer-in-Charge.

Manufacturing Tolerance: Dimensional extrusions shall be normally as per IS / BSS. Special tolerances shall be mutually agreed upon.

Tolerance on cut length:

i) The standard cut length is 3.66M the tolerance on cut length shall be as follows:

Length	Upto 6 metres	Over 6 metres
Tolerance	+ 5 mm	+ 7 mm

ii) Sections shall also be acceptable in random lengths between 1500 to 5000mm depending upon actual requirements. **Tolerance in Weights:** A tolerance of ± 10% shall be acceptable on Sectional weight per metre

o. Glazing:

Glazing work shall be as specified in the description of the item and / or as described under chapter : Glass & Glazing.

p. Scope of Work

This shall be same as described in the para "Scope of work" for Aluminium Curtain Wall System.

q. Execution of Work

i. This shall be similar to the Specifications for Aluminium Curtain Wall System as far as applicable.

Notes on Aluminium Curtain Wall System and structural glazing

1) Though both the systems i.e. curtain wall system and structural glazing are very much similar, stil the type and shape of aluminium extruded sections, that are used in this case are totaly different.

2) Another noted difference between the two systems is that in elevation the structural glazing looks as total glass surface without any beading visible externaly, whereas in case of curtain wal system the cover plate used on the surface is clearly visible in elevation.

3) A large quantity of sealant has to be used for the execution of the work of structural glazing with the result the cost per sqm. of structural glazing works out to be much on higher side.

4) There is also a slight difference in the actual fabrication of the two systems though quantity of materials required for execution in both the cases is same except the quantity of sealant.

r.	***Representative of the Contractor***	These shall be similar to the
s.	***Performance Guarantee***	Specifications for Aluminium Curtain
		Wall System as far as applicable
t.	***Measurements***	
u.	***Rate***	

* * *

44. CEMENT PLASTERING FOR WALLS & CEILINGS AND SAND FACE / ROUGH CAST PLASTERS :

v. SCOPE OF WORK :

The work covered under these specifications consists of supplying all materials and rendering all types of plaster/pointing finishes strictly in accordance with these specifications, applicable drawings etc. For all finishing works mentioned above, only blended cement shall be a used.

w. GENERAL :

Blended cement, sand and water required for the work shall conform to specifications laid down herein before under chapter 4 i.e. Plain and reinforced cement concrete, except that sand for finishing coat shall be fine sand conforming to I.S. 1542. The plastering works shall generally conform to I.S. 1661 (Pt. III) (Code of practice for cement and cement plaster finish on walls and ceilings). All general precautions as specified in I.S. 1661 (Pt. III) clause-8, shall be taken and preparation of the back ground shall be done as laid down in I.S. 1661 clause 12 and I.S. 2402 shall be generally followed for rough cast and sand faced plaster work. Scaffolding required for facility of working shall be provided by the contractor at his own cost. This may be double or single according to the requirement and shall be approved by the Engineer-in-Charge. Stage scaffolding shall be erected when ceiling plastering is done. The contractor shall be responsible for accidents, if any, take place. The contractor shall co-operate with the other agencies also. Whenever electrical contractor/agency has to fix up switch boxes in walls, necessary Thiyyas, Tapanish or Dhadas shall be arranged to be given in advance of actual plastering process at these locations so that the boxes are fixed properly in line with finished plaster surface. All finishing in and around these boxes as also around the conduit boxes in ceiling shall be done by plastering contractor without any extra cost . The decision of the Engineer-in-Charge in this regard shall be final and binding on the contractor. NO DRY CEMENT TO BE USED WHILE PLASTERING IT SHOULD BE IN MIXED STAGE. Portland Pozzolana cement (Fly Ash) shall be used for Plastering. Ready mix cement plaster of approved make shall be mixed and laid as per manufacturers specification.

x. PREPARATION OF SURFACE :

The surface to be plastered shall first be thoroughly cleaned of all muck and cleaned down. All joints shall be raked out in case of brick work / stone masonry and closely hacked in case of concrete, **under the relevant masonry / concrete items.** The surface to be plastered shall be well wetted for a minimum period of 6 hours before commencing the work. The mortar for all plaster work shall be blended cement mortar of mix as specified in the schedule of quantities.

After erection of scaffolding and before commencement of plastering work, top most junctions/joints/sides with beam/column shall be thoroughly packed with blended cement mortar to prevent cracks.

Before commencement of plastering operation, the contractor shall ensure that all the service pipes, electrical conduits, boxes, switch boxes etc. have been installed in position by other agencies and the plastering surface is duly approved by the Engineer-in-Charge. In order to enable other service contractors to fix the electrical conduits, conduit boxes, EDBs, pipes, outlets etc. in proper level and line with reference to the finished surface of the plaster, Thiyyas and Tapanis i.e. finished plaster patches shall be given by the main civil contractor on walls, ceiling at

regular intervals well in advance of his plaster work at no extra cost . The entire work of preparation of surface before plastering shall thus be co-ordinated by the main civil contractor with all other agencies working at site.

Just before actual plastering work is taken up in hand, all the ceilings and walls etc. shall be marked with Tapanis or Thiyyas indicating the thickness of plaster required and which shall be in true line, level and plumb. The contractor shall get these marks approved by the Engineer-in-Charge before starting the plastering work. The contractor shall also be responsible to render the final surface true to line, level and plumb etc.

All building operations like construction of walls, concreting etc. shall have been completed before plastering is taken up. The plastering operation should be taken up only after the service pipes etc. that are to be embedded in the wall or ceiling are completed and suitably protected against erosion by other agencies and okayed by the Engineer-in-charge. Damage if caused to any of the existing fittings, fixtures, including doors and windows etc. during the plastering operation shall be made good by the contractor at his own cost.

If the surface which is to be plastered either internally or externally is out of plumb and not in line and level and if the plastering to be done is more than specified thickness to bring the plastered surface to perfect line and levels, in such specific cases, chicken wire mesh is to be provided by the contractor at his own cost and the plaster should be done to required line and level with no extra cost whatsoever.

The finished plastered surface shall be free from cracks, fissures, crevices, hair cracks, blisterings, local swellings and flakings. The finished surface shall be true to line, level, plumb & plain and durable. The adhesion of the mortar with the background surface is of prime importance as this affects durability of plaster. Preparation of surface which has to take plastering is of great importance. Before starting the plastering work the surface should be got approved by the Engineer-in-charge.

In order to avoid the formation of deep and side cracks and for dispersion of cracks at the junctions between concrete surfaces and brick masonry work as also between junction of windows/door frames and brick masonry works, cautionary measures such as fastening and lapping of chicken mesh over the junction areas should be carried out over which the plastering work has to be taken up as required by the Engineer-in-charge.

The minute gap between window/door frames with cills and jambs should be filled up/caulked by plaster of paris/epoxy putty/silicon sealants, Rubber based sealants (brand name TECHMAT/TECHCOAT) by caulking guns or by approved methods as instructed/approved by Engineer-in-Charge.

y. GROOVES :

The grooves shall be of required dimensions. The same shall be made to turn wherever necessary. The finish, inside, shall be of the same finish as that of the plaster. The lines of the grooves shall be well defined and rounded. The grooves are to be provided in plastering in internal and external surfaces and shall be paid extra in the rates given in schedule of quantities.

z. MIX PROPORTIONS :

The mortar for plastering shall be of proportion as specified in the item schedule. The mixes specified in the schedule are volumetric.

aa. MIXING :

Cement and fine aggregates shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster.

Mixing shall be done mechanically. However, manual mixing will be allowed only in exceptional circumstances at the discretion of the Engineer-in-Charge. Manual mixing, where adopted, shall be carried out on a clean water tight platform. After water is added during mixing, the mix shall be held back and forth for 10 to 15 minutes.

In machine mixing, the mixer shall run atleast five minutes after placing all the ingredients in the drum. Only so much quantity of mortar which can be used within half an hour after the addition of water shall be prepared at a time. Any mortar for plaster which is set or partially set shall be rejected & shall be removed forthwith from the site.

6 / 12 / 15 MM. PLASTER :

The plaster shall be laid with somewhat more than 12 mm. thickness and pressed and levelled with wooden ruler to a finished thickness of 12 mm. Straight edges shall be freely used to ensure a perfectly even surface. All exposed angles and junctions of walls, doors, windows, beams, slabs etc. shall be carefully finished so as to furnish a neat and even surface.

Note: For 6mm plaster, approved bonding agent shall be used as per manufacturer's specifications, wherever specified in the Schedule of Items.

20 MM PLASTER :

The proportions of sand and cement shall be as specified and shall cover all irregularities, undulations, depressions due to chasing etc. in the surface to be plastered. The mortar shall be applied slightly more than 20 mm. thick and pressed and levelled with wooden ruler or straight edge to finished thickness of 20 mm. Straight edges shall be freely used to ensure a perfectly even surface. The finished surface shall be true and even and present uniform texture throughout and all joining marks shall be eliminated. All corners, edges and angles shall be made perfectly to line, plane and plumb. All exposed angles and junctions of walls, doors, windows, beams, slabs etc. shall be carefully finished so as to furnish a neat and even surface.

Plastering items amongst all other things as described in various items also include:

i) Preparation of surfaces to receive the plaster, providing cement plaster of the specified average thickness and proportions with specified number of coats.

ii) All labour, materials, scaffolding, use of tools and equipment to complete the

plastering work as per specifications.

iii) Curing for 10 days.

iv) Cleaning the surface of doors, windows, floors or any other surfaces where plastering might have splashed.

v) Finishing the portion of plaster left above the terrazo, plain cement tiles, ironite or any type of skirting work to be finished rounded or as directed by the Engineer-in-Charge, in a separate operation after laying of floor tiles skirting.

bb. **(A) NEERU FINISH :**

Wherever specified, the surface rendered shall be finished smooth with good quality lime neeru class 'C' conforming to I.S. 712-1956. The lime shall be tested in an approved testing laboratory for the chemical analysis of the lime and test certificate submitted regarding suitability of lime for plaster work. The cost of testing shall be borne by the contractor. Neeru shall be prepared at site out of best quality pure fat lime slaked at site with fresh water and slaked in accordance with the relevant I.S. code for slaking of lime. The slaked and sifted lime shall be reduced to a fine paste by grinding 150 turns in a mortar mill. Sufficient quantity, which can be used within 10 days only shall be prepared at a time. Chopped hessian or jute fibre in the required quantity may also be added to neeru and properly ground to pure paste as per directions of the Engineer-in-Charge.

An entire unobstructed area shall be plastered in one operation. Neeru shall be applied to the prepared and partially set but somewhat plastic surface with steel trowel to a thickness slightlty exceeding 1.5 mm. (1/16") and rubbed down to 1.5 mm. It shall be polished to perfectly smooth and even finish working from top to bottom for at least 3 days. All corners shall be truly brought to desired lines and levels in the base plaster along and the thickness of neeru shall not exceed 1.5 mm., at these locations. Moistening shall be commenced as soon as the plaster has hardened sufficiently and is not susceptable to injury. The surfaces shall be kept sprinkled with water for 7 days to prevent excessive evaporation. On the sunny or wind-ward side of the building in hot dry weather, matting or gunny bags may be hung over on the outside of the plaster and kept them wet. If blow holes are observed in neeru plaster at any time during the contract period and during the defect liability period, the contractor will have to rectify the defective neeru plaster work including redoing of the white washing/colour washing/distempering work etc. as the case may be, entirely at his own cost.

It shall be the contractors responsibility to ensure that cracks do not develop during the execution or subsequently during the defect liability period and the cracks if any observed shall be rectified including finishing, white washing/painting as specified, without any extra cost, to the entire satisfaction of the Engineer-in-charge.

44.7. (B)TEROL FINISH OF TERRACO :

Wherever specified, the surface rendered shall be finished smooth with 0.5 to 3 mm. thick coat of TEROL of TERRACO as per manufacturers specification. It shall be ensured that the surface to be covered is free of loose particles, dust, dirt, grease, oil and paint. TERROL shall be applied on top of finished coat of plaster which should be

levelled without any scratch/key marks. Adequate care should be taken that the first coat is levelled well to enable the thin layer TEROL plaster to give smooth finish, substrata/sub base should be moistened with water prior to the application of TEROL thin layer plaster.

1. **Mixing :** Put water into a clean empty drum. Add TEROL start stirring with paddle. Gradually add water and TEROL alternatively in the required proportion to get desired creamy consistency, convenient for application and stir continuously and ensure that no lumps remain. TEROL should not be allowed to stand without stirring for longer than 60 minutes. In normal condition let TEROL set for 5 minutes then stir and use. Where rapid drying conditions are prevalent, it is advisable to mix TEROL 20 minutes before using.

2. **Application :** TEROL is sprayed or hand applied and smoothened with a steel float. Smooth finishing shall be achieved with wooden floating or troweling when TEROL has set. The float should be moistened during the smoothening operation.

Curing the surface shall be carried out after 24 hours of application at least for 4 days using light water spray.

44.7 (C) PLASTER OF PARIS (POP – CaSO4 , 1 / 2H2O) FINISH :

Wherever specified, the wall / ceiling surfaces shall be finished smooth with approved quality Plaster of Paris (POP). POP shall be mixed in water for dehydration at site. Sufficient quantity, which can be used within half an hour only, shall be prepared at a time.

POP shall be applied immediately after the under coat of cement plaster has set. An entire unobstructed area shall be finished in one operation. POP shall be applied on top of finished coat of plaster which should be levelled without any scratch/key marks to the prepared and partially set. It shall be ensured that the surface to be covered is free of loose particles, dust, dirt, grease, oil and paint.It shall be applied with steel trowel to a thickness slightly exceeding 2 mm and rubbed down to 2 mm. It shall be polished to perfectly silk smooth and even finish working from top to bottom. All corners shall be truly brought to desired lines and levels in the base plaster along and the thickness of POP shall not exceed 2 mm, at these locations.

If blow holes / cracks are observed in POP plaster at any time during the contract period and during the defects liability period, the contractor will have to rectify the same including redoing painting to match with the adjacent surface etc., all at his own cost to the entire satisfaction of the Engineer-in-charge.

44.7 (D) GYPSUM PLASTERS

1.0 Material:

Requirement of premixed light weight gypsum shall be conforming to IS: 2547, Part-I &II latest revision. Product Package shall be ISI marked and material shall be got approved prior commencement of work.

Physical and Chemical requirement, sample testing to be carried out as per the IS: 2547 Part I&II cost of all test shall be born by contactor.

1.1. Surface Preparation for RCC: Smooth RCC surface to be hacked for bonding

(50 hacks per Sq. Ft.).

1.1.1. Any mould oil (Release oil) or other agents presents should be washed.

1.1.2. Normal ballast concrete should be given sufficient time to cure prior to application of plaster.

1.1.3. Any kind of loose masonry, foreign material adhering to the surface to be removed.

1.1.4. Recommending to use bonding agents to avoid any issue of debonding.

1.2. Application Methodology: The powder should be mixed with clean water preferably in clean plastic buckets to avoid mixing with impurities.

1.2.1. Mix gypsum plaster powders to water ensure through mixing by help of mixing rod has to avoid formation of lumps and unmixed residues.

1.2.2. Material should be thoroughly mixed and free from lumps and impurities before use.

1.2.3. Water to plaster ratio should be as per manufacture recommended.

1.2.4. When the mix has begun to set it should not be further added with additional water or dry material.

1.2.5. Material should always apply above 6" from skirting level.

1.2.6. Can apply gypsum in the thickness range of 3.25 mm. However when applying gypsum plaster in thickness excess of 12-13 mm it has to be applied in layers of 10 mm each and not the whole thickness of 25-30 mm in one single layer.

1.2.7. Similar will be the application process for RCC columns and wall where it has to be applied in layers. However in ceiling it is not recommended to go beyond thickness of 13 mm even it applied on Bond IT or Hacked surface.

1.3. RATE: - Rate quoted shall be all heights and floors including cost of material, scaffolding, transporting, testing , labour and of additional thickness due to variation in plain and plumb etc.

1.4. MODE OF MEASURMENT: Mode of measurement will be as per schedule of quantities.

45 SAND FACED CEMENT PLASTER:

45.1GENERAL : Materials and preparation of surfaces and scaffolding etc. for sand faced plaster wherever applicable shall conform to specification laid down here-in-before under section cement plastering and the following specifications are also to be complied with:

PREPARATION OF SURFACE : The surface to be plastered shall first be thoroughly cleaned down. All joints shall be raked out in case of brick work / stone masonry and closely hacked and wire brushed in case of concrete, **under the relevant masonry / concrete items.** The surface to be plastered shall be well wetted for a minimum period of 6 hours before commencing the work. The mortar for all plaster work shall be cement sand mortar of mix as specified in the schedule of quantities.

Double scaffoldings required for facility of construction shall be provided by the contractor at his own expenses wherever directed by the Engineer-in-Charge. Scaffolding shall be erected with pipes or ballies or bamboos of adequate strength so as to be safe for all the dead, live and impact loads likely to sustain by it during construction operations. The contractor shall take all measures to ensure the safety of the work and workmen. Any instruction of the Engineer-in-Charge in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to Government property or injury to persons, resulting from faulty scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach for workmen and supervisory staff to every part of the work. Ballies, bamboos etc. for scaffolding shall not be tied to the windows, doors, mulliions, ventilators etc. Any damage done to the windows, doors etc. shall be made good by the contractor to the original conditions at his own cost. For better safety, steel pipe scaffolding is preferred.

WORKMANSHIP : The surface to be plastered shall first be dubbed out with cement mortar to cover all irregularities and faces upto proudest part. The dubbing coat which shall be of proportion as specified in schedule and a 12 mm. thick (1/2") layer shall then be applied/scored and keys shall be formed on the surface by thoroughly combing it with heavy horizontal lines about 12 mm. (1/2") apart and about 3 mm. (1/8") deep when mortar has just set.

The cement mortar for sand faced plaster shall have washed and approved sand with slightly larger proportions of coarse materials, but not exceeding 3 mm. The proportion of cement to sand shall be as specified in the schedule. The water is gradually added to make the mixture homogenous. The thickness of finishing coat excluding key shall be 8mm. (about 5/16"). After application the surface should be finished with a wooden float lined with cork closely pricked on with a wet sponge tapped gently to bring sand particles into prominence.

The chajjas and any other horizontal portions shall be cleaned and set mortar that might have been fallen at the time of plastering at higher elevation, before plastering work is taken up. Junction of wall and chajja shall be rounded off simultaneously as directed by the Engineer-in-Charge.

46 **ROUGH CAST PLASTER** :

All materials shall conform to the standards already specified for plaster described above. The preparation of the surface to received the rough cast plaster shall be as described under sand face plaster. Rough cast plaster shall be carried out in two coats. First coat shall consist of 1 part of cement to 3 parts of clean sand or as specified otherwise. The finished thickness of the first coat shall be 12mm. and shall be laid by throwing the mortar (By using strong whipping motion) on the prepared surface with a trowel in a uniform layer but shall not be smooth. The second coat consists of 1 part of cement and 3 part of 6 mm. to 10 mm. down gravel all as approved by the Engineer-in-Charge. The gravel shall thoroughly be got cleaned with water removing all dirt and other organic materials. All these ingredients shall be mixed into a paste which shall be flung upon the first coat with large trowels to form

an even protective coat. The second coat must be applied while the first coat is still soft and unset. The thickness of this coat shall be 10 mm. only. Due care shall be taken to avoid concentration of either large size or small size of gravel in one place. A sample of rough cast plaster shall also be got approved by the Engineer-in-Charge as regards the texture etc. before proceeding further with the work. All subsequent work shall generally conform to the approved sample panel. The finished work shall be cured for a minimum period of seven days.

General workmanship, scaffolding, preparation of surface, curing etc. shall conform to the specification already laid down under sand faced plastering.

The contractor shall take special care at the time of plastering or pointing to keep the m.s./aluminium window/wallspan etc. fixed by other agency in correct shape, position and to cover the same with required hessian cloth/gunny bags to keep away from sprinkling of plasters/paint etc. The damage caused to the above if any, shall be made good by the contractor at his own cost.

MODE OF MEASUREMENT:

Area of plastering will be measured net and shall be paid for. The measurement of length of wall plastering shall be taken between walls or partitions (dimensions before plastering shall be taken) for the length and from top of the floor or skirting or dado as the case may be to the underside of ceiling for the height. All openings more than 0.1 sqm. shall be deducted and all jambs, soffits, sills of these openings if done, will be measured to arrive to the net area for payment. No opening less than 0.1 sqm. shall be deducted and no jambs etc. for such openings shall be measured for payment. The rate shall include the cost of finishing all the edges, corners, cost of all materials, labours, scaffolding, transport, curing etc.

The rate shall include the cost of finishing all the edges, corners, cost of all materials, labour, transport, scaffolding, curing etc. and grooves if so specified in the item of schedule of quantities.

The rate for plastering should include the cost of work towards the following items for co-ordination with electrical item:

1. Neatly plastering around DBs, junction boxes, M.S. boxes etc. should be done and made matching with the wall finish after installation of electrical equipments.

2. All DBs, service boxes, covers etc. should be covered by a plastic cloth or other suitable covering materials such that water or materials should not splash the same during brick work and plastering work. This is to be done in such a way that electrical equipments as well as painted surfaces are not spoiled.

3. For fixing M.S. boxes, DBs etc. Thiyya should be given such that the required face of the M.S. box, DB covers etc inline with final finished plastered surface.

4. The rate for the item shall also include rounding up of corner and angles making sharp corners and angles finishing around ceiling rose and electrical fittings etc. fixed by other agencies, finishing of top of dado and skirting (zad

finishing), junctions of roof and wall or beam with the finish as specified in the item. Plastering of brick and concrete cornice and copings and plastering in restricted areas if any shall not be measured separately. Architectural bands and narrow widths of plaster over structural as well as non-structural and the line when prepared in the same thickness of plaster shall not be measured separately and shall be covered by respective plaster items.

ROUGH CAST PLASTER : The area of surfaces actually plastered will be measured net and shall be paid for. The measurements of length and height of wall plastered shall be correct to a centimeter taken between walls or projections including the width of corner edge strips including the areas of grooves. All the openings more than 0.1 sqm. shall be deducted and all jambs, soffits and sills of these openings, if plastered will be measured to arrive at the net area for the payment. No opening less than 0.1 sqm. shall be deducted and no jambs etc. for such openings shall be measured for payment. Corner/edges finishing will not be measured separately and the rate shall include the cost of finishing all the edges, corner strips in addition to the cost of all materials, labour, transport, scaffolding, curing etc. and grooves if so specified in the item of schedule of quantities.

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47. CEMENT POINTING :

PREPARATION OF SURFACE :

The joints shall be raked out properly **under masonry item.** Dust and loose mortar shall be brushed out. Efflorescence if any, shall also be removed by brushing and scrapping. The surface shall be thoroughly washed with water, cleaned and kept wet before pointing is commenced.

MORTAR :

Mortar mix for pointing shall be as described in the schedule of quantities. Specifications for cement, sand and water shall be as described herein before for concrete works.

APPLICATION OF MORTAR & FINISHING :

The mortar shall be pressed into the raked out joints with a pointing trowel, either flush, sunk, ruled or raised according to type of pointing specified in the schedule of quantities. The mortar shall not spread over the face of brick work or stone work, corners, edges of the masonry but restricted to the width of joints only.

The super-fluous mortar shall then the struck off and the surface of the masonry shall be cleaned off completely. The finish shall be such that the pointing is to the exact size and shape stipulated and the edges are straight, neat and clean. The pointing lines shall be straight, regular and uniform. No false joints shall be allowed.

CURING :

The pointing shall be kept wet for atleast seven days. During this period it shall be suitably protected from all damages.

TYPES :

(a) **Raised and Cut Pointing :** Raised and cut pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6 mm. raised and width 10 mm. or more as directed.

(b) **Flush Pointing :** The mortar pressed into the joints shall be finished off flush and level with the edges of bricks, tiles or stones so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edges.

(c) **Ruled Pointing :** The joints shall be initially formed as for flush pointing and then while the mortar is still green, a groove of shape and size as directed shall be formed by running a forming tool straight along the centre line of the joints. This operation shall be continued till a smooth and hard surface is obtained. The vertical joints shall also be finished in a similar way. All vertical lines shall make true right angles at their junctions with horizontal lines and shall not project beyond the same.

MODE OF MEASUREMENT :

The area of surface actually pointed will be measured net and shall be paid for. The measurement of length and height of walls pointed shall be taken correct to a centimetre. All the openings of doors, windows, ventilators etc. shall be deducted and jambs, soffits, sills etc. if pointed will be measured to arrive at the net area for the payment. The rate shall include cost of all materials, labour, transport, scaffolding, curing etc.

* * * *

48WALL CARE PUTTY

48.1SCOPE OF WORK:

Wall care putty consists of white cement, high quality polymers and specialty chemicals and mineral fillers and is formulated to make it suitable to apply even on damp surfaces. Being cement based putty, it has better compatibility with the base plaster and forms a durable base for paints. It can be applied on both, Interior and exterior plastered surfaces. It is a water resistant base coating to the plastered surfaces to provide fine leveling and a protective base for the surfaces to be painted.

GENERAL:

Wall care putty shall have superior water resisting properties to prevent paint from flaking even if the walls are damp. It should fill-up fine pores in walls and ceilings to get the smooth and dry surface for painting. Wall care putty shall have better properties in terms of water-resistance, adhesive strength and durability as compared to the ordinary putties. The putty shall provide a breathable surface and allow any trapped moisture to move out keeping the wall dry and clean.

MATERIAL:

Wall care Putty shall be in dry free flowing powder form. Required quantity of Wall care putty shall be procured from the reputed manufacturers like M/s. Birla White Wall Care Putty / M/s. Walplast Products Pvt. Ltd. or equivalent approved manufacturers, or from their authorised dealers. The putty shall conform to the International standards (viz. HDB-Singapore Standards with Water-resistant properties).

The putty shall be procured in the form of FINE or COARSE (MATT) finish as specified in the description of the item.

PREPARATION OF SURFACE:

- Surface should be clean of loose particles, dirt, grease and traces of foreign material. Sand papering or chipping shall be done if so required.
- Loose plastered areas/defective materials shall be removed & surface re-plastered and cracks filled-up properly.
- Uneven ceiling/wall surfaces shall be made even by re-plastering.
- Surface should be pre-wetted prior to application. This helps in providing a strong bond with substrate.

MIXING:

- 12 to 16 litres of clean water shall be required for a bag of 40 kg of wall care putty. Required quantity of putty (which is required to be used at a time) shall be added to the water in right proportion. (considering pot life of the mix as 60 minutes).
- Mix shall be stirred continuously by using an electric mixer or by hand to obtain a homogeneous lump-free paste.
- The paste shall be allowed to stand for about 10 minutes for the additives to dissolve.
- The paste shall be re-mixed again for about 2 minutes.
- This mix should be used within 60 minutes.

APPLICATION:

- The plastered surface shall be dampened with clean water and excess water shall be allowed to be drained-off.
- Using a steel trowel/blade, the above mix shall be applied to a thickness of about 1 – 2 mm. Then the surface shall be levelled and smoothened. This first coat shall be cured lightly after it dries-up.
- Then second coat shall be applied after first coat is fully dried and set. Second coat shall be cured lightly for two days.

- Over plastered / Coarse putty substrate, fine wall care putty of about 1 to 1.5 mm thickness shall be applied, to smoothen the surface with a steel trowel. Finished surface of wall care putty shall not require any dressing by Emery Paper but if at all it is done, the paper should not be less than 500 number.

- The thickness of each coat should not exceed 1.5mm and total wall putty thickness should not exceed 3mm.

- If specified in the description of item, coarse wall care putty of about 6 to 10 mm thickness shall be applied to remove the undulations and level the surface. More number of coats of coarse putty shall be applied to cover up undulations, only after approval of the Engineer-in-Charge.

- Coverage of wall care putty depends upon surface quality. However, approximate coverage for fine wall care putty shall be 20-22 Sqft/kg and for coarse wall care putty, it shall be 9-10 Sqft/kg.

- Application of primer before painting is not necessary over the surfaces finished with wall care putty.

SPECIFICATIONS

Specification of Wall care putty – For smooth Finish			
SL. NO.	**PROPERTY**	**AS PER HDB (HOUSING DEVELOPMENT BOARD), SINGAPORE**	**TEST METHOD**
	Dry Adhesion	>=0.8 N/sqmm	EN 1015-12
	Wet Adhesion	>=0.3 N/sqmm	Chinese Std.
1	Tensile Adhesion Strength (N/sqmm) @ 28 Days	>0.8 N/sqmm	EN-1348
2	Compressive Strength (N/sqmm) @ 28 Days	7-12 N/sqmm	EN 1015-11
3	Setting Time (Minutes) - Initial & Final	<360 <500	EN 196
4	Water Absorption Coefficient - Kg/M². H1/2	<=0.13 for W2 / <=0.26 for W1	EN 1015-18
5	Water Capillary Absorption (ML) @ 24 Hrs.		Karsten Tube

6	Water Retentivity %	>=95%	EN 1015-8
	PH	Alkaline	

NOTE:

Putty being white cement based, it is alkaline, and hence direct eye and skin contact should be avoided. In case of eye contact, flush the same with clean water for 15 minutes and seek medical help.

* * *

49. PAINTING :

49.1. SCOPE OF WORK :

The work covered under these specifications consist of furnishing the various types of paints and also the workmanship for these items, in strict compliance with these specifications, which are given in detail here-in-after with the item of schedule of quantities.

49.2. MATERIALS :

Paints, oils, varnishes etc. of approved brand and manufacture shall be used. Ready mixed paints as received from the manufacturer without any admixture shall be used.

If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-in-Charge shall be used. Approved paints, oils or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition. The materials shall be brought in at a time in adequate quantities to suffice for the whole work or atleast a fortnights work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-charge. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the Engineerin-Charge.

The contractor shall associate the chemist of paint manufacturers before commencement of work, during and after the completion of work who shall certify the suitability of the surface to receive painting and the paint before use etc.

49.3. COMMENCING WORK :

Scaffolding : Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being painted.

Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

For painting of the ceiling, proper stage scaffolding shall be erected.

Painting shall not be started until and unless the Engineer-in-Charge has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work.

Painting, except the priming coat, shall generally be taken in hand after all other builders work, practically finished.

The rooms should be thoroughly swept out and the entire building cleaned up at least one day in advance of the paint work being started.

49.4. PREPARATION OF SURFACE :

The surface shall be thoroughly cleaned. All dirt, rust, scales, smoke and grease shall be thoroughly removed before painting is started. Minor patches if any in plastered/form finished surfaces shall be repaired and finished in line and level in C.M. 1:1 and cracks & crevices shall be filled with approved filler, by the contractor at no extra cost. The prepared surface shall have received the approval of the Engineer-in-Charge after inspection, before painting is commenced.

49.5. APPLICATION :

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers. When applying also, the paint shall be continuously stirred in the smaller containers so that consistency is kept uniform.

The external surfaces of the buildings under reference including the R.C.C. Jalli, fins and the panels above and below the window etc. shall be finished in different colours of approved shade. The contractor will make suitable samples at site for E.I.C approvel before taking up the work in hand and they will be allowed to proceed with the work only after getting E.I.C approval for the same.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the later in the direction of the grain in case of wood. The crossing & laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternately in opposite directions two or three time and then finally brushing lightly in 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 will constitute one coat.

Where so stipulated, the painting shall be done with spraying. Spray machine used may be (a) 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 condition prevails.

Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be fecilitated by thorough ventilation.

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

No left over paint shall be put back into the stock tins. When not in use, containers shall be kept properly closed.

The final painted surface shall present a uniform appearance and no streaks, blisters, hair marks from the brush or clogging of paint puddles in the corners of panels, angles of mouldings etc. shall be left on the work.

In case of cement based paints/primers, the absorbent surfaces shall be evenly damped so as to give even suction. In any weather, freshly painted surfaces shall be kept damp for atleast two days.

In painting doors and windows, the putty around the glass panes must also be painted, but care must 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 while painting. Perspect covers of electrical switch boxes have to be painted from inside by removing them. Care shall be taken while removing them in position after painting with respective approved paints. 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 as in accordance to the detailed specifications under the respective headings.

Any damage caused during painting work to the existing works/surfaces shall be made good by the contractor at his own cost.

49.6. BRUSHES AND CONTAINERS :

After work, the brushes shall be completely cleaned off paint and linseed oil by rinsing with turpentine. 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 closed, kept air tight and shall be kept at a place free from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean & can be used again.

49.7. MEASUREMENT :

a) Painting, unless otherwise stated shall be measured by area in square metre. Length and breadth shall be measured correct upto two places of decimal of a metre.

b) No deduction shall be made for opening not exceeding 0.05 sqm. and no addition shall be made for painting to the beading, moulding edges, jambs, soffits, sils, architraves etc. of such openings.

c) In measuring painting, varnishing, oiling etc. of joinery and steel work etc., the co-efficients as in the following table shall be used to obtain the areas payable. The co-efficients shall be applied to the areas measured flat and not girthed in all cases.

d) In case of painting of door shutter with push plates in plastic laminate,

deduction will be made for area of such laminations.

49.7.1. Table of multiplying Co-efficients to be applied over areas of different surfaces to get equivalent plain areas is given in the Appendix-"C-2" of this book.

49.7.2. Explanatory notes on the table of Co-efficients.

1. Where doors, window etc. are of composite types other than those included in para 47.7 (c), the different portions shall be measured separately with their appropriate co-efficients, the centre line of the common rail being taken as the dividing line between the two portions.

2. Measurements for doors, windows etc. shall be taken flat (and not girthed) over all including chowkhats or frames, where provided. Where chowkhats or frames are not provided, the shutter measurements shall be taken.

3. Collapsible gates shall be measured for width from outside to outside of gate in its expanded position and for height from bottom to top of channel verticals. No separate measurements shall be taken for the top and bottom guide, rails, rollers, fittings etc.

4. Rolling shutters of interlocked laths shall be measured for the actual shutter width and the height from bottom of opening to the centre of the shaft. No separate measurements shall be taken for painting guides and other exposed features within or outside the shutter area. The painting of top cover or hood shall however be measured separately.

5. Co-efficients for sliding doors shall be the same as for normal types of doors as mentioned in the table. Measurements shall be taken outside of shutters, and no separate measurements shall be taken for painting guides, rollers, fittings etc.

6. Measurement of painting of doors, windows, collapsible gates, rolling shutters etc. as above shall be deemed to include painting all iron fittings in the same or different shade for which no extra will be paid.

7. The measurements as above shall be deemed to include also the painting of edges, blocks, cleats etc. for which no extra will be paid.

8. The co-efficients for doors and windows shall apply irrespective of the size of frames and shutter members.

9. When the two faces of a door, window etc. are to be treated with different specified finishes, measurable under separate items, the edges of frames and shutters shall be treated with the one or the other type of finish as ordered by the Engineer-in-Charge, and measurement of this will be deemed to be included in the measurement of the face treated with that finish.

10. In the case where shutters are fixed on both faces of the frames, the measurements for the door frame and shutter on one face shall be taken in the manner already described, while the additional shutter on the other face will be measured for the shutter area only excluding the frame.

11. Where shutters are provided with clearance at top or/and bottom, such openings shall be deducted from the over all measurements and relevant co-efficients shall be applied to obtain the area payable.

12. In case of trellis (or jaffri) work, the measurements shall include the painting of the frame member for which no separate measurements shall be taken. Trellis door or window shutters shall also be measured under terllis work.

13. Wherever air conditioning grill, lighting, fixtures etc. in false ceiling are painted along with, measurements shall be taken over all without deductions for opening in grills and no extra shall be paid for the grills. If grills, fixtures etc. are not painted, area of fixtures or grills as measured flat (not girthed) shall be deducted when it exceeds 0.05 sqm. individuals. Where walls and ceilings are painted in separate colours, the junctions of two paints shall be brought down on the walls in a straight line by about 6mm to 12mm. if so desired, if the junctions of walls and ceilings are not even. Nothing extra shall be paid to the contractor on this account. Beading wherever provided shall not be measured separately but shall be deemed to be included in the area of false ceiling etc. measured flat (not girthed).

14. For painting open palisade fencing and gates etc., the height shall be measured from the bottom of the lowest rail, if the palisades do not go below it, (or from the lower end of the palisades, if they project below the lowest rail), upto the top of rails or palisades whichever are higher, but not up to the top of standards when the latter are higher than the top rails or palisades.

15. In the case of asbestos cement corrugated or semi-corrugated sheeting and iron corrugated sheeting in roofs, side cladding etc., the work shall be measured flat (not girthed) as fixed.

16. For trusses, compound girders, stanchions, lattice girder and similar work, actual areas will be measured in sqm. Or as per BOQ (Schedule of quantities) under structural steel and no extra shall be paid for painting on bolt heads, nuts, washers etc. even when they are picked out in a different tint to the adjacent work.

17. Painting of rain water, soil, waste, vent and water pipes etc. shall be measured in running metres of the particular diameter of the pipe concerned. Painting of specials such as bends, heads, branches, junctions, shoes etc. shall be included in the length and no separate measurements shall be taken for these or for painting brackets, clamps etc.

18. Measurements of wall surfaces and wood and other works not referred to already shall be recorded as per actual and opening exceeding 0.05 sqm. shall be deducted to get the net payable area. Length and breadth shall be measured correct upto two places of decimal of a metre and area so worked out shall be correct upto two places of decimal of a square metre.

19. In case the items of work requiring painting are inclusive of cost of painting, the painting carried out shall not be measured separately.

49.8. PRECAUTIONS :

All furnitures, lightings, fixtures, sanitary fittings, glazing, floors etc. shall be protected by covering and stains, smears, splashings, if any shall be removed and any damage done shall be made good by the contractor at his cost.

49.9. RATES:

Rates shall include cost of all labour and materials involved on all the operations described above and in the particular specifications given under the several items.

49.10. (A) PAINTING PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES :

49.10.1. Primer

1. The primer for wood work, iron work or plastered surface shall be as specified in the description of the item.

2. **Primer for Wood work / Iron & Steel / Plastered / Aluminium surfaces shall be as specified below:**

SN	SURFACES	PRIMER TO BE USED
a	Wood work (hard & soft wood):	Pink conforming to
b	Resinous wood and ply wood:	Aluminium primer
c	Iron & Steel, Aluminium and galvanised Steel	Zinc chromate primer conforming to
d	Plastered surfaces, cement brick work, Asbestos	Cement Primer

3. The primer shall be ready mixed primer of approved brand and manufacture.

47.10.2 Preparation of surface :

a) **Wood work :** The wood work to be painted shall be dry and free from moisture.

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material with same shade as paint shall be used where so desired by the Engineer-in-charge.

The surface treated for knotting shall be dry before painting is applied. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glaziers putty or wood putty (for specifications for glaziers putty and wood putty- refer as mentioned here-in-before). Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is therefore liable to crack.

b) **Iron and Steel Work :** All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.

If the surface is wet, it shall be dried before priming coat is undertaken.

c) **Plastered Surface :** The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of paris and rubbed smooth.

49.10.2. Application : The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described here-in-before.

49.10.3. Other Details : The specifications for Painting (General) shall hold good so far as it is applicable.

49.11. (B): PAINTING WITH SUPERIOR QUALITY & FLAT OIL READY MIXED PAINTS ON NEW SURFACE :

49.11.1. Paint : Ready mixed paints shall be of approved brand and manufacture and of the required shades. They shall conform in all respects to the relevant I.S. specifications.

49.11.2. <u>Preparation of Surface:</u>

(a) **Wood work :** The surface shall be cleaned and all unevenness removed as in para 47.10.2 (a). Knots if visible, shall be covered with a preparation of red lead. Holes and indentations on the surface shall be filled in with glaziers putty or wood putty and rubbed smooth before painting is done. The surface should be thoroughly dry before painting.

(b) **Iron and steel work :** The primer coat shall have dried up completely before painting is started. Rust and scaling shall be carefully removed by scraping or by brushing with steel wire brushes. All dust and dirt shall be carefully and thoroughly wiped away.

(c) **Plastered surfaces :** The priming coat shall have dried up completely before painting is started. All dust or dirt that has settled on the priming coat shall be thoroughly wiped before painting is started.

49.11.3. Application : The specifications mentioned here-in-before shall hold good as far as applicable.

The number of coats to be applied will be as stipulated in the item. The painted surface shall present a uniform appearance1 and glossy/semiglossy finish, free from streaks, blisters etc.

49.11.4. Other details : The specifications for Painting (General) specified here-in-before shall hold good in so far as they are applicable.

49.12. (C) PAINTING WITH SYNTHETIC ENAMEL/SEMI GLOSSY PAINT ON NEW WORK :

1. Paint : Synthetic enamel/semi glossy paint of approved brand and manufacture

and required shade shall be used for the top coat and an under coat of shade to match the top coat as recommended by the manufacturer shall be used. The paint shall be conforming to IS : 1932-1 964.

2. **Preparation of Surface :** This shall be as per painting with superior quality ready mixed paint as mentioned here- in- before.

3. **Application :** The number of coats including the under coat shall be as stipulated in the item.

   3.1. Under Coat : One coat of the specified paint of shade suited to the shade of the top coat shall be applied and allowed to dry over night. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface free from brush marks and all loose particles shall be dusted off. All the cracks, crevices, roughness etc. will be filled with approved putty as per manufacturers recommendations.

   3.2. Top Coat : Finishing coats of specified paint of the desired colour & shade shall be applied after the under coat is thoroughly dried. Additional finishing coats shall be applied if found necessary to ensure a proper and uniform semi glossy surface.

4. **Other Details :** The specifications for "Painting (General)" mentioned here-in-before shall hold good as far as they are applicable.

49.13. (D) PAINTING WITH ACRYLIC EMULSION/PLASTIC EMULSION PAINT.

1. This shall be polyvinyl based Acrylic/plastic emulsion paint of approved manufacture of the required shade, conforming to I.S.5411-1969.

2. Primer: The primer to be used for the painting with acrylic emulsion on cement concrete surfaces, plastered surfaces, A.C. sheets, timber and metal surfaces, if necessary, shall be of approved base and as per recommendations of the manufacturers.

3. Putty : Plaster filler to be used for filling up (putting) uneven surfaces, small cracks and holes etc. shall be of approved compound and as per recommendations of the manufacturers. No oil based putty shall be used. The putty should be made from a mixture of whiting and plastic emulsion paint or as per manufacturers recommendations.

4. Finishing coats : All the finishing coats shall be of matt finish or any other finish as required by the Engineerin-charge. The number of finishing coats shall be as specified in the item.

MODE OF MEASUREMENT :

All the measurements for payment shall be taken on net surface area actually painted, unless otherwise specified. Deduction will be made from the areas for fixtures, grills, ventilation, outlets, electrical boxes and such obstructions not painted, if they are individually more than 0.05 sqm.

JOB REQUIREMENTS :

i) Acrylic emulsion paint is required to be provided on plastered and concrete surfaces in portions of the building. The E.I.C shall reserve the option to delete or increase quantities in full or part from the scope of contract during progress of work.

ii) All wood surfaces are to be painted with semi glossy synthetic enamel paint with an approved primer.

iii) All shades and colours of paints shall be subjected to review and prior approval of Engineer-in-Charge shall be taken before the application.

49.14. WHITE WASHING WITH LIME

49.14.1. Preparation of Surface : Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings and foreign-matter.

In the case of old work, all loose pieces and scales shall be scrapped off and holes in plaster as well as patches of less than 0.05 sqm.area each shall be filled up with mortar of the same mix. Where so specifically ordered by the Engineer-in-charge, the entire surface of old white wash shall be thoroughly removed by scrapping and this shall be paid for separately.

49.14.2. Preparation of lime wash : The wash shall be prepared from fresh stone white lime "Katani" or equivalent. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm. of gum dissolved in hot water, shall be added to each 10 cubic decimetre of the cream. The approximate quantity of water to be added in making the cream will be 5 litres of water to one kg. of lime.

Indigo (Neel) up to 3 gm. per kg. of lime dissolved in water, shall then be added and wash stirred well. Water shall then be added at the rate of about 5 ltrs. per kg. of lime to produce a milky solution.

The lime shall be tested in a chemical laboratory and test certificate submitted, to conform the quality of lime with regard to its physical and chemical properties. The cost of testing lime shall be borne by the contractor.

49.14.3. White Washing ``: The white wash shall be applied with brushes or by spray in the specified number of coats. The operation for each coat in the case of brush application shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer-in-charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface present a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any sign of cracking and peeling nor shall it come off readily on the hand when rubbed.

For old work, after the surface has been prepared as described here-in-before, a coat of white wash shall be applied over the patches and repairs. Then a single coat or two or more coats of white wash as stipulated in the description of the item shall be applied over the entire surface. The white washed surface should present a uniform finish through which the plaster patched do not appear. The washing on ceiling should be done prior to that on walls.

49.14.4. Protective Measures : Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed shall be protected from being splashed upon. Splashings and droppings, if any, shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to painted surfaces, furnitures or fittings and fixtures etc. shall be recoverable from the contractor.

49.14.5. Measurements : All measurements for payment shall be taken on net surface areas actually white washed, unless otherwise specified. Deductions will be made from the areas for fixtures, grills, ventilation, outlets, electrical boxes and such obstruction not painted if they are individually more than 0.05 sqm. Length and breadth shall be taken correct upto two places of decimal of a metre and areas so worked out shall be correct upto two places of decimals of a square metre.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area.

Corrugated asbestos cement sheets	20 %
Semi-corrugated asbestos cement sheets:	10 %

The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 0.05 sqm. each with materials similar in composition to the surface to be prepared.

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

49.15. COLOUR WASHING:

In the case of colour washing, mineral colours, not affected by lime, shall be added to white wash with proper glue. No colour wash shall be done until a sample of the colour wash to the required tint or shade has been got approved from the Engineer-in-Charge. The colour shall be of even tint or shade over the whole surface. If it is

patchy or otherwise badly applied, it shall be redone by the contractor, at no extra cost.

For new work, the priming coat shall be of white wash lime or with whiting as specified in the description of the item. Two or three coats, shall then be applied as specified on the entire surface till it represents a smooth and uniform finish. Each coat after applying shall be got approved from the Engineer-in-Charge.

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

Other specifications as detailed for Whitewashing with lime shall be applicable. Indigo (Neel) shall however, not be added.

49.16. DRY DISTEMPERING :

(a) **Distemper :** Dry distemper (IS:427-1965) of approved brand and manufacture, colour and required shade shall be used. The dry distemper shall be stirred slowly in clean water using 0.6 litre of water per kg. of distemper or as specified by the manufacturers. Warm water shall preferably be used. It shall be allowed to stand for atleast 30 minutes before use. The mixture shall be invariably well stirred before and during use to maintain an even consistency.

(b) **Preparation of surface :** This shall be as for Painting work mentioned here-in-before in so far as it is applicable.

(c) **Application :** In case of new work, the treatment shall consist of a priming coat followed by the application of two or more coats of distemper till the surface shows an even colour.

i) Priming coat : Priming coat of whiting shall be applied over the prepared surface. The whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form a thin slurry which shall then be screened through a clean coarse cloth. Two kg. of gum and 0.4 kg. of copper sulphate dissolved separately in hot water shall be added for every cum. of the slurry which shall then be diluted with water to the consistency of milk so as to make a wash ready for use. No white washing coat shall be used as a priming coat for distempering.

ii) The application of each coat as mentioned in the specifications for painting (General) here-in-before, shall hold good, as far as it is applicable.

49.17. OIL EMULSION (OIL BOUND) DISTEMPERING :

(a) Oil bound distemper (IS:428-1969) of approved brand and manufacture, colour and required shade shall be used. The primer where used as on new work shall be cement primer or distemper primer as specified in the item. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by manufacturer. Only sufficient quantity of distemper required for days work shall be prepared.

(b) Preparation of surfaces : The surface shall be prepared as described here- in-before for Painting work in so far as it is applicable and approved putty/filler

shall be applied to the entire area to get uniform and smooth surface before application of primer.

Application: The cement primer or distemper primer shall be applied by brushing and not by spraying. Hurried priming work shall be avoided, particularly on absorbent surfaces. New plaster patches in old work before applying oil bound distemper shall be treated with cement primer/distemper primer. The surface shall be finished as uniformly as possible leaving no brush marks. priming coat shall be allowed to dry for at least 48 hours before oil bound distemper is applied. Before applying distemper,the surface shall be lightly sand prepared to make it smooth for receiving the oil bound distemper, taking care not to rub out the priming coat. A time interval of at least 24 hours shall be allowed between consecutive coats to permit the proper drying of the preceding coat. Two or more coats of distemper as are found necessary shall be applied over the priming coat to obtain an even shade.

(c) Other details : The specifications for "Painting (General)" mentioned here-in-before shall hold good as far as it is applicable.

49.18. WATER PROOFING CEMENT BASED PAINT :

a) **Material:** Cement based paint (IS:541 0-1 969) of approved manufacture, quality, shade and colour only shall be used.

b) **Preparation of surfaces :** The surface shall be thoroughly cleaned off all mortar dropping, dirt, dust, algae, grease and other foreign matter by brushing and washing the surfaces. The surface shall be thoroughly wetted with clean water before the water proof cement paint is applied. The prepared surface shall be got approved before painting is commenced.

The water proof cement paint shall be mixed in such quantities as can be used up with in an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish.

Water proof cement paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of water proof cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the water proof cement paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain liquid of workable and uniform consistency. In all cases the manufacturers instruction shall be followed meticulously.

c) **Application:** The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. To avoid direct heat of the sun during painting, the cement based paint shall be applied on the surface which is on the shady side. Cement based paint shall not be applied on the surfaces already treated with white wash, colour wash, dry or oil bound distemper, varnishes, paints etc. It shall not be applied on gypsum, wood and metal surfaces.

d) **Other details :** The specifications for Painting (General) mentioned here-in-before shall hold good as far as they are applicable.

e) **Mode of measurement for dry distemper, oil bound distemper and water proof cement paint :** All measurement for payment shall be taken on net surface area actually painted unless otherwise specified and no co-efficient shall be applied for working out areas. Deductions will be made from areas for opening/obstructions not painted, if they are individually more than 0.05 sqm. Length and breadth shall be taken correct upto two places of decimal of a meter and areas shall be worked out correct upto two places of decimal of a square meter.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentage to allow the girthed area: a) Corrugated asbestos cement sheets - 20%; b) Semi corrugated asbestos cement sheets - 10%.

The number of coats of each treatement shall be stated in the schedule of quantities. The whole surface shall be applied with approved putty/filler to get uniform and smooth surface at no extra cost.

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

49.19. BEES WAXING OR POLISHING WITH READY MADE WAX POLISH:(NEW WORK) :

49.19.1. Materials : The polishing shall be done with bees waxing prepared locally or with ready made wax polish of approved brand and manufacture, as stipulated in the description of item.

a) Where bees waxing is to be prepared locally, the following specifications for the same shall apply:

Pure bees wax free from paraffin or stearing adulterants shall be used. Its specific gravity shall be 0.965 to 0.969 and melting point shall be 63o C. The polish shall be prepared from a mixture of bees wax, linseed oil, turpentine and varnish in the ratio of 2: 1 .5: 1: 0.5 by weight.

The bees wax and boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved, the mixture shall be cooled till it is just warm and turpentine and varnish added to it in the required proportions and the entire mixture shall be well stirred.

49.19.2. Preparation of surface : Preparation of surface will be as mentioned here-in-under para 47.20.2 with the exception that knotting, holes and cracks shall be stopped with a mixture of fine saw dust formed of the wood being treated, beaten up with sufficient bees wax to enhance cohesion.

49.19.3. Application : The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then rubbed continuously for half an hour.

When the surface is quite dry, a second coat shall be applied in the same manner and rubbed continuously for one hour or until the surface is dry.

The final coat shall then be applied and rubbed for two hours (more if necessary) until the surface has assumed a uniform gloss and is dry showing no sign of stickiness.

The final polish depends largely on the amount of rubbing which should be continuous and with uniform pressure, with frequent changes in the direction.

49.19.4. Other details : The specifications for painting (General) as mentioned here-in-before shall hold good as for as they are applicable.

49.20. FRENCH SPIRIT POLISHING: (ON NEW WORK WITH A COAT OF WOOD FILLER) :

49.20.1. Polish : Pure shellac varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm. of shellac to 1 litre of spirit. Suitable pigment shall be added to get the required shade.

49.20.2. Preparation of surface : The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted off. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glaziers putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1 .5 kg. of whiting per litre of spirit. The surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

49.20.3. Application : The number of coats of polish to be applied shall be as described in the item.

A pad of woolen cloth covered by fine cloth shall be used to apply the polish. The pad shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

49.20.4. Measurement, Rate and other Details : These shall be as for Painting (General) mentioned here-inbefore as far as they are applicable.

NOTE: Consumption of paint for some painting items is given in Appendix – "C-1".

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49.21. RESIN BASED THERMO PLASTIC PAINT (DECORATIVE AND PROTECTIVE FINISH) :

49.21.1. Materials : Resin based thermo plastic paint such as Sandtex Matt or other equivalent approved manufacture, colour and shade shall only be used.

49.21.2. Preparation of Surface & General : The Specifications for Painting (General)described here-in-before shall hold good as for as they are applicable.

49.21.3. Protective Coatings : On surfaces such as ferrous metals, brass, copper and phospher bronze, a protective coating of suitable bituminous compound or chromated red oxide should be given. New wood should be treated with a leafing grade aluminium primer or a water based acrylic emulsion primer.

The surfaces with algae growth shall be thoroughly cleaned down to remove as much growth as possible and effective solution of stabilized house hold bleach (calcium hypochloride) of approved quality with approximate 35% chlorine content @ 2 kgs. per 50 ltrs. (or as per manufacturers recommendations) should be used to treat the surfaces.

On chalky or friable surfaces after removing the loose materials by stiff brushing or scraping the surface should be treated with one coat of advanced solvent based material such as snowsol stabilizing solution or other approved equivalent with white spirit.

49.21.4. Application: The ready mix Sandtex Matt or other equivalent approved resin based thermo plastic paint shall be applied on clean and wetted surfaces by means of brushes or roller. The solution shall be kept well stirred during the period of application. To avoid direct heat of the sun, the paint shall be applied on the side in shade.

On rough and textured surfaces, one under coat of cement based paint such as Snowcem or other equivalent shall be applied before application of undiluted Sandtex Matt finish coat. In case of application of two coats of Sandtex Matt at normal temperatures, the first one shall be diluted by addition of 25% water and the second coat direct. In extremely hot environs, the second coat shall be diluted @ 2.5 ltrs. of water to 20 ltrs. of paint or as directed.

Painting with resin based thermo plastic paint shall be carried out generally as per manufacturers specifications.

49.21.5. Other Details : The specification for Painting (general) mentioned here-in-before shall hold good as far as they are applicable.

Snowsol stabilized solution shall not be applied over bitumen. Snowsol stabilized solution treated surfaces shall not be left unpainted for more than 2 (two) days. Gypsum based materials shall not be used for filling of exterior cracks while preparation of surfaces.

49.21.6. Mode of Measurement : The painting unless otherwise mentioned shall be measured by area in sqm. upto two places of decimal. Length and breadth shall be measured correct upto two places of decimal of a meter. Deduction will be made from the areas of fixtures, grills, ventilation, outlets individually more than 0.05 sqm.

The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 0.1 sqm. each with materials similar in composition to the surface to be prepared.

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

* * *

50. VINERATEX OR VITROBRITE DECORATIVE TEXTURE COAT :

50.1. GENERAL :

Vineratex or vitrobrite decorative treatment/coating consisting of coating the plaster finished surfaces with decorative texured coat of ready mixed mixture of approved aggregate with bonding compound/synthetic adhesive manufactured by M/s. Vinera Industries & Co. or other approved manufacturer. The vineratex or vitrobrite treatment coating shall be got done through approved agency as per manufacturers recommendations.

The vineratex or vitrobrite treatment shall be applied/coated directly over the sub-base of reasonably smooth/levelled and clean surface like plastered brick work (plaster not being raked or scratched) in-situ concrete, precast concrete units, light weight blocks, asbestos cement sheet etc. as specified.

50.2. MATERIAL :

The various aggregate and special bonding media/synthetic resin shall be strictly as per manufacturers recommendations. Only such aggregates shall be used, which are weather and corrosion resistant viz. glass, ceramic marble, chips, granite, quartz and flint, hametites, pyrites or one in natural vitrified, coloined or other processed forms as specified. The aggregate shall vary in sizes from 0.5 mm. to 2.5 mm. and shall be applied in shades as specified. The finish shall have a film thickness of 3 mm. average.

50.3. SURFACE PREPARATION :

Before commencing, the surfaces should be cleaned thoroughly to remove any grease, dirt, dust or loose particle and should be free from surface water. Extremely porous surfaces should be pre-sealed with a thin coat of suitable primer. Previous painted surfaces if any, should be prepared by thoroughly scrapping off all loose flaking paint film, washing down with a suitable detergent and rinsing thoroughly with clean water and allowed to dry.

50.4. APPLICATION :

Vineratex or vitrobrite shall be brought to site in sealed containers. Addition of thinner at site will not be permitted. The material in the containers shall be mixed thoroughly before use, to off-set the settlement occurred due to heavy vibration while transporting and during storage.

A small amount of Vineratex or vitrobrite mixture shall be placed on a spot board. The spot board shall be held against the surface on which the treatment/coating is to be

applied. The mixture shall be applied to the surface evenly with the help of laying on trowel to uniform thickness of about 3 mm. on an area of about 0.18 sqm. Scrap off the excess material with the help of the steel float to obtain an even film thickness of 3 mm. This shall be achieved by using the steel float held slightly on the trailing edge, putting an even pressure and scrapping off the excess material/mixture, left on the spot board shall be immediately put back into drum and shall be mixed well before reuse.

Level of the vineratex or vitrobrite film to a smooth and even finish using the flat edge of steel float. It is important that only small areas of about 0.18 sqm. shall be treated at a time. Wherever possible, whole work should be completed without stop in one operation by engaging sufficient number of workers, so that flowing edge may be maintained without forming any joint. If this is unavoidable, a suitable natural break in the application should be chosen and the joint shall be made using a straight edge, which can be continued when application is resumed the following day. Over lap or over troweling at joints shall be avoided. This treatment shall always be carried out in shade, away from full effect of hot sun.

At all times the completed work of vineratex or vitrobrite shall be protected against rain fall until complete hardness has been obtained which takes about 24 hours.

Once the treatment/coating is completed and set hard, no other treatment like polishing, cleaning, washing with acid etc. shall be resorted to in this area. The treatment/coating shall be taken up in hand when all other construction works viz. plastering, electrical wiring, plumbing, painting etc. have been completed.

After the whole work is completed, the vineratex/vitrobrite shall be given a coat of anti-fungus gel to avoid fungus growth on surfaces. The contractor shall be responsible to protect the finished surface from any damages for whatever reason whatsoever.

50.5. MODE OF MEASUREMENT :

Mode of measurement shall be similar to sand faced/roughcast plaster items.

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5 1. TUBULAR TRUSSES, PURLINS ETC. :

51.1. Structural Steel Tubes : These shall be of :

i) hot finished welded (HFW) type, or

ii) hot finished seamless (HFS) type, or

iii) electric resistance or induction butt welded (ERW), having carbon content less than 0.03%, yield stress of 21.5 kg./mm. (YST 22) type, conforming to the requirement of I.S. 1161-63. The steel tubes when analysed in accordance with the method specified in I.S. 226-1959.

Tubes shall be designated by their nominal bore. These shall be light, medium or heavy as specified, depending on the wall thickness.

Tubes shall be cleanly finished and reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut cleanly and square with the axis of tube, unless otherwise specified.

51.2. MINIMUM THICKNESS OF METALS : The tubular steel work shall be painted with one coat of approved epoxy steel primer after fabrication. Wall thickness of tubes used for construction exposed to weather shall be not less than 4 mm. and for construction not exposed to weather, it shall be not less than 3.2 mm., where structures are not readily accessible for maintenance, the minimum thickness shall be 5 mm.

51.3. FABRICATION :

51.3.1. The component parts of the structure shall be assembled in such a manner that they are neither twisted nor otherwise damaged and be so prepared that the specified cambers, if any, are maintained.

51.3.2. Straightening : All material before being assembled shall be straightened, if necessary, unless required to be of a curvilinear form and shall be free from twist.

51.3.3. Bolting : Washers shall be specially shaped where necessary, or other means used, to give the nuts and the heads of bolts a satisfactory bearing.

In all cases where the full bearing area of the bolt is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together, and washers of appropriate thickness shall be provided to allow the nut to be completely tightened.

51.3.4. Welding : Where welding is adopted, it shall be done as per relevant I.S. 820.

51.3.5. Caps and Bases for Columns : The ends of all the tubes for columns, transmitting loads through the ends, should be true and square to the axis of the tube and should be provided with a cap or base accurately fitted to the end of the tube and screwed, welded or shrunk on. The cap or base plate should be true and square to the axis of the column.

51.3.6. Sealing of Tubes : When the end of a tube is not automatically sealed by virtue of its connection by welding to another member, **the end shall be properly and completely sealed**. Before sealing, the inside of the tube should be dry and free from loose scale.

51.3.7. Flattened Ends : In tubular construction the ends of tubes may be flattened or otherwise formed to provide for welded, rivetted or bolted connections, provided that the methods adopted for such flattening do not injure the material. The change of sections shall be gradual.

51.4. HOISTING AND ERECTION :

Tubular trusses shall be hoisted and erected in position carefully, without damage to themselves, other structure, equipment and injury to workmen. The method of hoisting and erection proposed to be adopted shall be got approved from the

Engineer-in-charge. The contractor shall however be fully responsible, for the work being carried out in a safe and proper manner without unduly stressing the various members. The contractor shall have to grout the bolts in column tops to receive the truss wall plates, hoist the trusses in position, erect it in a perfect line, level and plumb, fix it in position with nuts, bolts etc., cure the grouted portion and paint the truss with two coats of epoxy paint as per drawing of approved colour and shade over a coat of approved steel epoxy primer. Proper equipment such as derricks, lifting tackles, winches, scaffolding, propping, ropes etc. shall be used.

51.5. MODE OF MEASUREMENT : The work as fixed in place shall be measured in running metres correct to a centimetre and their weights calculated on the basis of standard tables correct to the nearest kilogram, unless otherwise specified.

Weight of cleats, brackets, packing pieces, bolts , nuts, washers, distance pieces, separators diaphragm gussets (taking overall square dimensions) fish plates etc. shall be added to the weight of respective items unless otherwise specified. No deduction shall be made for skew cuts.

51.6. RATE : The rate shall include the cost of labour and materials involved in all the operations described above including one coat of approved steel primer and painting as specified in the item.

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52. ASBESTOS CEMENT CORRUGATED / TRAFFORD SHEET ROOFING :

A.C. sheets, big six/trafford and accessories shall be supplied by the contractor as per terms and conditions stipulated in the Schedule A.

LAYING :

The sheets shall be laid on the purlins and other roof members as indicated on the working drawings or as instructed by the Engineer-in-charge.

The top bearing surfaces of all purlins and of other roof members shall be in one place so that the sheets when being fixed shall not require to be forced down to rest on the purlins. The finished roof shall present a uniform slope and the lines of corrugations shall be straight and true. The sheets shall be laid with the smooth side upwards. The sheets shall be laid with a side lap of half a corrugation and an end lap of 6" (15.2 cm.) minimum.

Side laps should be laid on the side facing away from the prevailing monsoon winds.

The free over hang of the sheets at the eaves shall not exceed 30 cm. Corrugated sheets shall generally be laid from left to right starting at the eaves. The first sheet shall be laid uncut, but the remaining sheets in the bottom row shall have the top left hand corners cut or Mitred. The sheets in the second and other intermediate rows except the first and the last sheets, shall have both the top left hand corner and bottom right hand corner cut. The first sheets in those rows shall have only the bottom right hand corner mitred, while the last sheets shall have only the top left hand corner cut. The last or top row sheets shall have the bottom right hand corner cut with the exception of the last sheet which shall be laid uncut. If for any reason

such as considerations of the direction of prevailing winds, laying must be started from the bottom right hand corner, then the whole procedure should be reversed.

The Mitre described above is necessary to provide a snug (close) fit where four sheets meet at a lap. It is cut from a point 15 cm. (or whatever the length of the end lap may be) up the vertical side of the sheet to a point 5 cm. along the horizontal edge. This cutting may be done with an ordinary wood saw at site.

52.1. FIXING :

Sheets shall be secured to the purlins and other roof members by means of 8mm. diameter galvanised iron J or L hooks bolts and nuts. The grip of the J or L hooks bolts on the side of the purlin shall not be less than 25 mm. Each G.I. J or L hook bolt shall have a bitumen washers and galvanised iron washers placed over the sheet before the nut is screwed down from above. On each purlin there shall be one hook bolt on the crown adjacent to the side lap on either side. Bitumen washer shall be of approved manufacture.

Each nut shall be screwed loosely at first. After a dozen or more sheets are laid, the nuts shall be tightened to ensure a leak proof joint.

Holes for hook bolts etc. shall be drilled and not punched in the ridges of the corrugations in the exact positions to suit the purlins while the sheets are on the roof in their correct position. The diameter of holes shall be 2mm. more than the diameter of the fixing bolts. No hole shall be nearer than 40mm. to any edge of a sheet or any accessory.

Roof ladders or planks shall always be used when laying and fixing the sheets, to avoid damage to the sheets, and to provide security to the workmen.

Wind Ties : Wind ties shall be of 50 x 6 mm. flat iron section or of other size as specified. These shall be fixed at the eave ends of the sheets. The fixing shall be done with the same hook bolts which secure the sheets to the purlin. Wind ties shall be paid for separately unless described as included in the items of the roof work.

Finish : The completed roof shall present a neat and uniform appearance and shall be leak proof.

52.2. MODE OF MEASUREMENT :

The measurements for A.C. roofing sheets actually laid shall be taken for the finished work in superficial areas flat in the plane of the roof and not girthed. The laps between the A.C. corrugated sheets both at the ends and at the sides shall not be measured. The over laps of the corrugated sheets over valley gutters, roof light sheets, and eaves filler pieces and the underlay of the corrugated sheets below ridges, hips, north light curves, apron flashing pieces and barge boards shall be included in the measurement and paid for. Deductions will be made in the measurements for roof light sheets if any, but no deduction shall be made for holes cut for extractors or cowl type ventilators.

Length and breadth shall be measured correct to a centimetre and its area calculated in square metre correct to two places of decimal. Roof with curved sheets

shall be measured and paid for separately. The breadth of the roof shall be measured along the trough of the curved sheets.

No deduction in measurements shall be made for opening in roof for chimney stacks, ventilators etc. of area upto 0.4 sqm. nor shall any extra be paid for extra labour in cutting, wastage etc. informing such openings. For openings exceeding 0.4 sqm. in area, deductions shall be paid for extra labour involved in cutting, wastage etc. in forming such openings.

52.3. RATE :

The rate shall include the cost of all materials, and labour involved in all the operations described above. The rate shall not include the cost of roof members, wind ties and specials such as finals, ridges, hips, valleys, north light curves, apron flashing pieces, barge boards, cowl type ventilators, extractors and roof light sheets, which shall be paid for separately. The rate of the item shall be deemed to be for straight sloping roofs.

50-A. A.C. RIDGES :

A.C. corrugated ridges shall be supplied in pairs as per schedule A. The ridges in pairs shall be transported to site of work, hoisted, placed and fixed in position at the junction of the two sloping sides of a roof. Care shall be taken to match the corrugations of the sheets with the ridges. The ridges shall be embedded in the end wall to the same extent of the roofing sheets. If any small gap remains between the ridges and the roofing sheets, the same shall be rendered water proof by the contractors, with cement mortar 1:2 and as directed by the Engineerin-charge at no extra cost. The overlapping of adjacent A.C. ridges shall be as per manufacturers specifications, scaffolding if any shall be provided by contractors at their own cost.

50-A.1. MODE OF MEASUREMENT :

Linear measurements for the pairs of ridges shall be taken between the finished surfaces of the end walls and shall be correct upto two places of decimal of a metre. No laps or embedment shall be considered for measurements.

The rate shall include all operations involved including cost of contractors materials, tools and plants, labour etc. No damages or losses shall be permitted.

50-B. A.C. EAVE CURVES :

A.C. corrugated eave curves shall be supplied by the Contractor. The eave curves shall be transported to site of work, hoisted, placed and fixed in position in perfect line and level with hooks, nuts, washers etc. with the over laps provided as per manufacturers code of practice. The holes for hooks shall be drilled and not punched. The areas around hooks shall then be made water tight. The eave curves shall be embedded in the gable walls to the same extent as that of A.C. sheets. Scaffolding, props etc. if required, shall be provided by the contractors at their own cost.

50-B.1 MODE OF MEASUREMENT :

Measurements shall be taken between the finished surfaces of walls and shall be correct upto two places of decimal of a metre. No laps or embedments shall be measured for payment.

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53. MANGALORE PATTERN TILE ROOFING :

53.1. SCOPE OF WORK AND GENERAL :

The item refers to supplying and laying manglore tile roofing with lime mortar bedding 1:2 over R.C.C. slab. Lime mortar required for this job shall conform to specifications given here-in-before.

53.2. MATERIALS :

Mangalore (Basel mission or equivalent) tile shall be double channeled tiles and shall conform to I.S. 654-1957 for class-AA or class-A type tiles or as specified in the item description. The sample of tiles shall be got approved before procuring materials on mass scale and incorporating in works. Mangalore tiles (Basel mission or equivalent) manufacture shall be made of the best malabar clay, well dried and thoroughly burnt in patent kilns. The tiles shall be well burnt, close grained homogeneous without segregated lumps of clay and shall have a breaking strength of not less than 102 kg. (2 CWT) applied at a centre of span when supported on battens at 350 mm. centres. The absorption co-efficient after 24 hours soaking shall not exceed 1/6th of its own weight.

53.3. LAYING :

Mangalore tiles of approved make and quality shall be well soaked in water for four hours before taking up for laying. The mortar of specified proportion and thickness shall be spread and the mangalore tiles fully embedded thereon, without any air spaces, where the tiles breaking joints.

The tiles shall be laid from the eves towards ridge. Where full tiles are not necessary, half tiles manufactured for the purpose only shall be used. The laying of Mangalore tiles and laying of lime mortar shall go on concurrently. The ridge mangalore tiles shall be of standard type duly approved and shall be set in lime mortar as specified. Finished top slope of roof shall be uniform from ridge to eves. Eves line and the ridge line and all intermediate lines shall be perfectly straight, horizontal and parallel to each other. The lowest layer of tiles at the eves shall have cut edges instead of round edges and/or as directed by the Engineer-in-Charge. All joints shall be pointed with lime mortar 1:2 with mixture of red ochre to preserve uniformity of colour and the joints shall be made perfectly secured and water tight.

53.4. CURING :

After laying of Mangalore tiles as specified, roofing shall be watered and cured for a minimum period of 7 days and as per specifications specified for curing for flooring. After curing is over, the roof shall be thoroughly cleaned and all excess stays of mortar etc. shall be scraped off.

53.5. MODE OF MEASUREMENT :

The rate shall be per square meter of actual area of roofing completely finished. The area shall be measured net without any laps. Opening for sky lights, cut outs etc. upto 0.4 sqm. shall not be deducted and where applicable no cutting for forming such openings shall be measured. The linear dimensions shall be measured flat from edge to edge of tiled roof and area worked out correct upto two places of decimal. Ridge tiles laid shall be measured in running metre. Portion covered by ridge tiles shall not be measured under roofing tiles. The rate shall include providing, erecting and removing scaffolding and necessary ladders. Also it shall include all labour, materials, transport, cleaning, curing etc. to complete the job as specified.

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54. FALSE CEILING WITH FLEXO BOARDS / A.C. SHEETS :

54.1. SCOPE OF WORK :

The work envisaged under these specifications refer to supplying and fixing in position false ceiling at any floor, any location and at any height.

54.2. MATERIAL :

The plain A.C. sheet or flexo board shall be of the thickness as mentioned in the relevant items of the schedule of quantities and the size of panels and the arrangement of panels etc. for different area of the building shall be as indicated by the Engineer-in-Charge. Plain A.C. sheet or flexo board shall be of approved quality and shall be free from cracks, bends and other defects. Samples of materials to be used on the work shall first be furnished by the contractor and got approved by the Engineer-in-Charge. All materials which are used on the works shall strictly conform to the samples, other-wise the materials shall be summarily rejected.

The plain A.C. sheet or flexo board shall be fixed to the angle iron frames (frame work paid separately) work by means of suitable counter sunk brass self tapping screws not more than 200 mm. centre to centre or as directed, and all holes after fixing the screws be filled with approved filler. Necessary openings in the ceiling shall be left for trap doors, ducts etc.

54.3. ERECTION :

The flexo boards/A.C. sheets when brought to site shall be stacked carefully on floor over wooden sleeper supports. The boards shall be cut to required sizes either by sawing or by score and snap method. The edges shall be smoothened by wood rasp file or with emery paper. Wherever required the edges of each panel may require bevelling which also shall be done carefully to the correct line and dimensions.

The flexo boards/A.C. sheets shall be fixed to ridge frames either wooden or metallic or mentioned in the item description. In case of metallic frame, the flexo boards are held to the frame by means of self tapping screws or by the ordinary machine screws and nuts, as directed by the Engineer-in-Charge.

Teak wood or aluminium beadings if required to be fixed shall be as mentioned in the item description and shall be carried out in best workman-like manner.

Any other treatment for finishing such as gluing of wall papers, cement or oil based paint etc. shall be as specified in the item description and shall be done as per relevant specifications.

54.4. MODE OF MEASUREMENT :

Unless otherwise mentioned, the wooden or metallic-frame work shall be separately measured and paid for. The flexo board/A.C. sheet false ceiling shall be measured in square metre as actually laid over the frame work. The area being worked out correct to two places of decimal with length and breadth measured correct to a centimeter. The rates shall include the cost of all materials, labour, scaffolding etc. as mentioned above and in item description, unless otherwise specified.

52.A. A.C.SHEET FALSE CEILING AND MASKING ETC. WITH PRESSED STEEL FRAME WORK/ANODIZED ALUMINIUM FRAME WORK :

52.A-1 GENERAL:

The work covered by these specifications shall consist of furnishing all labour, materials and equipment necessary for installation of the suspended false ceiling and vertical masking, with A.C. sheet on pressed steel frame work, inter locking, Aluminium frame work suspended by adjustable M.S. suspenders with necessary cut outs in the A.C. sheet for lighting fixtures, trap doors, A.C. grills etc., providing m.s. lighting troughs etc., erecting to proper line and level in the specified areas, floors and levels as indicated in the drawing and as directed by the Engineer-in-Charge.

52.A-2 MATERIALS :

All materials which are to be in-cooperated in work shall be got approval prior to bulk procurement.

52.A-2.1 Fabrication of Pressed Steel Frame : The frame work for "snap grid" false ceiling shall be made out of tested special springs grade steel or approved cold rolled sheets of specified gauge as per schedule, accurately formed and die cuts with identical ends in automatic machine with precision tools. All workmanship shall be best quality as followed in a modern sheet metal shops equipped with all machines such as press, dies, spot welding machine, baking oven etc. All materials shall be done by a process approved by the Engineer-in-Charge and in a manner that will not damage the materials. All work shall be accurately formed to the required dimensions, true to line, level and plane in all directions and properly sized to suit the exact dimension within permissible tolerances. Twisted or bent sections shall not be permitted to be used on work. Main runners and cross tees shall be of sizes as specified in the

schedule/shown in the drawing. The main runners shall be slotted for cross tees and punched for hangers/suspenders. Cross tees shall have identified die formed ends accurately cut for easy, correct and proper fit assembly. Shearing, cropping shall be clean, reasonably square and free from distortion. Surfaces and joints to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign materials. The surface shall be wire brushed vigorously. Welding sequence shall be followed to avoid needless distortion and minimise shrinkage stresses. Holes to be made in pressed M.S. sheet shall not be made by flame cutting. The flame cut or unfair holes are not acceptable connection of supported members with erection clearance for all members. Where for practical reasons greater clearance is necessary, suitable designed seating should be provided. Any damages done to the walls/ceiling shall be reinstated to original condition. The contractor shall not be entitled for any extra cost on this account.

52.A-2.1.1 Suspended Aluminium Grid system : Aluminium grid system shall be of BESTLOK/EEZILOCK or equivalent approved standard suspended aluminium grid system. The suspended ceiling grid shall be of self interlocking anodised aluminium T bars for main runners and cross runners of specified section and pattern as required to suit the span as per drawing.

52.A-2.2 A.C. Sheets : A.C. sheet shall be plain and of specified thickness, approved best quality and shall conform in all respect to the relevant Indian Standard Specifications.

The sheets shall be free from cracks, chipped edges or corners, twist dents, rough patches and other damages etc.

52.A-2.3 M.S. Works : All MS works shall conform to relevant specification mentioned under Structural Steel here-in-before.

52.A-2.4 Fastening : All bolts, nuts, screws, fittings & fixtures shall be of best quality and of approved manufacture.

52.A-3 FIXING :

The contractor shall take all necessary field measurements before the commencement of the frame work to ensure proper fittings of the work to actual condition of work at site. Particular care should be taken to examine the positions of all recessed lighting, trap doors and other openings indicated on drawings or as directed by the Engineer-in-Charge. The correct panel sizes shall be decided to suit each location. The false ceiling levels shall then be marked on walls. Mark the position of the runners to suit the span of the area. Fix up the wall angles with approved metal fasteners and level then correctly. The position of suspender shall then be marked on the R.C. slab as per the sizes of the panels decided for each area with due consideration to location of air-conditioning ducts, grills etc. Suspenders of type and design fabricated as per drawing and approved by the Engineer-in-Charge, shall then be securely fixed at correct points with approved metal fasteners/expansion bolts of specified dia., as per manufacturers specifications. It shall be ensured that the hanger/suspender shall remain perpendicular and not pulled by the suspension system to any side. Fix up the runner to the suspenders and lock up the runners at the joints,

complete the levelling starting from the fixed points and proceed towards the other end. Fix up the the cross tees to every runner joints to have stability while levelling. Neoprene rubber gasket shall then be fixed all along the frame work with approved type of adhesive. Approved A.C. sheets cut to correct sizes shall then be placed on the runner, starting from the centre of the width and work side wards. Connect all cross tees and put on the approved spring type hold down clip/pins as per drawing. Holes if required to be provided in A.C. sheets shall be drilled and on no account holes shall be punched. Lock the runner tees and tiles with hold down clips/pins as required. Wherever grouting for frame work, suspenders etc. is required to be done in masonry walls columns/beams etc., the same shall be done after the entire frame work is properly levelled.

The contractor shall take into consideration all wastage in the A.C. sheets, aluminium grid system frame work/pressed steel frame work, M.S. suspenders, screws, nuts, bolts, washers etc. required for fixing A.C. sheet false ceiling and vertical masking while quoting his rates. A.C. sheet false ceiling and vertical masking shall be fixed to pressed steel frame or Aluminium grid system by means of spring clip (brass counter sunk machine screws in case of masking) of approved size, make and at approved spacing or as shown in drawing or as instructed. After fixing the A.C. sheets, all holes of screws etc. shall be filled with approved putty, levelled with the A.C. sheets and sand papered, so that no sign of screw is visible on the A.C. sheets. For all the A.C. sheets false ceiling and vertical masking work, the A.C. sheet of required size and shape shall be cut as per approved panel size shown in drawing and fixed on pressed steel frame in the best workman like manner.

Trap doors/lighting recesses/troughs of approved size and shape with approved matching work, shall be provided in the false ceiling and vertical masking at the specified places.

Any damage done to the walls/columns/ceilings/plasters/floors etc. shall be made good to the original condition at his own cost. The contractor shall not be entitled for any extra cost on this account. During the execution of this work, the contractor shall take all the precautions to prevent damage to the painted surface, plaster, floor tiles, doors etc. Contractor should specifically note that the area where the false ceiling is required to be provided will be in advance stage of completion with various finishing items such as painting, floor polishing etc. Any damage to these finishes will have to be made good by him at no extra cost .

52.A-4 SAFETY PRECAUTIONS :

No person other than workman employed by the false ceiling contractor shall be permitted access to any area over which the sheeting is being laid. The contractor should take protective measures during the progress of work. Cat ladders or roof boards, scaffolding etc. should invariably be used by men working on the roof/false ceiling/masking etc.

52.A-5 WORK TO INCLUDE :

Cost of all approved A.C. sheets with anodized aluminium/pressed steel frame work, adjustable m.s. suspenders m.s. cleats, nuts, bolts, washers, screws, all labour, materials, tools, plants, approval scaffoldings, providing m.s. cleats and

fixing them with metal fasteners/expansion bolts, nuts, washers, screws etc. to the concrete/wall surfaces and then fixing the adjustable suspenders in m.s. clamps, painting two coats of synthetic enamel paint on m.s. work as directed/as shown in drawing.

52.A-6 MODE OF MEASUREMENT :

A.C. Sheet false ceiling with snap grid pressed steel/anodized aluminium internal grid system frame work completed and accepted as per above specifications shall be measured in square metre upto two places of decimals. The line measurements shall be taken upto two places of decimal of a metre. The width shall be measured, from wall angle to wall angle and length shall be measured as per actual. Areas of trap doors, lighting troughs, Air conditioning diffusers, Air conditioning grills and other openings shall be deducted and net areas of false ceiling so computed shall be paid for unless other wise specified.

Areas of false ceiling with additional horizontal M.S. angle supports as per relevant drawing shall be measured separately between such additional supports. Mode of measurement for this item shall also be in square metre as described above.

52.B LIGHTING TROUGHS / FIXTURES :

Lighting troughs/fixtures shall be fabricated out of anodized aluminium sheet or out of m.s. sheet of specified gauge and shall be free from scale, blisters, laminations, cracked edges, defects of any sort and shall conform to relevant I.S. specifications.

Lighting troughs shall be fabricated in a modern, well equipped workshop, as per the size and profile given in the drawing. The M.S. lighting trough shall be stove enamelled in the shop with approved type of colour & shade on both the surfaces. Aluminium troughs shall be anodized as per standard practice. Sample of lighting trough fabricated as per drawing shall be got approved by the Engineer-in-Charge before manufacturing on large scale. Aluminium/M.S. frame work sections and sizes, as per drawing, shall be fabricated and got approved before fixing in position.

The m.s. lighting troughs along with m.s. frame or aluminium lighting troughs with aluminium frame shall be fixed in position to correct line and level with m.s. suspenders as per drawings. One or more sample lighting troughs shall be fixed in position and got approved before fixing all the lighting troughs. The end of the lighting troughs on both sides shall be provided with m.s. covers of the same gauge as per drawings.

The materials and fabrication of lighting trough, m.s. aluminium frame and suspenders shall conform to the relevant specification given in this tender. The m.s. work shall be painted with two coats of synthetic enamel paint of approved make and shade over a coat of approved primer as per specification under relevant head.

52.B-1 MODE OF MEASUREMENT :

The lighting troughs along with m.s. or aluminium frame work, suspenders, end covers etc. duly fixed in position shall be measured along the length of the trough in running metres upto two places of decimal of a metre and paid for unless otherwise specified in schedule of work.

52-C TRAP DOORS :

The materials viz. M.S. frame, aluminium frame and A.C. sheet and fabrications shall conform to the relevant specification given in this tender.

The trap doors shall be fixed in position with necessary M.S. angle frame out of M.S. angle of size 40 x 40 x 6mm. for the shutter and fixed to M.S. wall angle of size 40 x 25 x 6 mm. which is to be fixed by means of 40 x 25 x 6 mm. M.S. angle cleats, fixed to wall by means of M.S. hold fasts out of M.S. flats of size 40 x 6mm., 150 mm. long and grouted with cement concrete 1:2:4 in case of brick wall and with 100 mm. long M.S. coach screws and rawl plugs in case R.C. columns etc. M.S. angle of size 40 x 25 x 5 mm. shall be provided for receiving the lever of the locking arrangement. This angle shall be supported by 40 x 6 mm. M.S. flat suspenders from ceiling fixed with 3/8" diameter metal fasteners/expansion bolts. This angle, meant to receive the lever of the lock, shall be supported by two numbers of M.S. angle of size 40 x 25 x 5 mm. on either side. The two angles also shall be provided with M.S. flat (40 x 6 mm.) suspenders @ 800 mm. centers at all other convenient spacing as per drawing and as approved by the Engineer-in-Charge.

Sample of trap doors of single, double and multi panels shall be fabricated and fixed in position and got approved before taking up fabrication of trap doors on large scale.

All the exposed surfaces of M.S. work including the suspenders shall be painted with two coats of synthetic enamel paint of approved make and shade over a coat of approved primer.

52.C-1 MODE OF MEASUREMENT :

The area of trap door visible from underside of the false ceiling only shall be measured in square metres for payment. The m.s. angles to be provided for locking arrangements and supporting M.S. angles which shall not be seen from underneath shall not be measured for payment and are supposed to be included in the rate quoted for trap door, unless otherwise specified in the schedule of work.

52.D FIBRE GLASS THERMAL INSULATION WORK AT CEILING WITH T.W. BATTENS FRAME WORK AND COVERING WITH A.C. SHEET :

52.D-1 SCOPE OF WORK :

The work envisaged under these specification covers providing and fixing fibre glass thermal insulation to ceiling at any floor, location and height as specified including T.W. battens frame work in required grid and insulation work covered with A.C. sheet/flexo board of specified thickness.

52.D-2 MATERIALS :

i) **T.W. battens for frame :** Battens required for frame work shall be as specified under chapter "Wood work in frames, shutters and panelling".

ii) **Thermal insulation media :** The thermal insulation media shall be of fibre glass Crown 150 or equivalent approved make with K value of 0.0285 K. Cal / sqm. hr. 0C, 50 mm. thick and density of 24 kg/cum. or as specified in the description of item/ in drawing. Sample of fibre glass to be used on the work shall first be furnished by the contractor and got approved from Engineer-in-Charge before mass procurement.

iii) **A.C./Flexo board sheet covering :** The plain A.C. sheet or flexo board shall be as specified here-inbefore.

iv) **Fire resisting paint :** The fire resisting paint shall be of M/s. Garware Paints Ltd. or any other approved equivalent make and shall conform to I.S. 163. Sample of fire resisting paint to be used on work shall first be got approved from Engineer-in-Charge before bulk procurement. Ready mixed paint as received from the manufacturer without any admixture shall be used.

52.D-3 ERECTION / FIXING OF INSULATION :

i) **Frame work :** The workmanship shall be of best quality. All wrought timber is to be sawn, drilled or otherwise machine worked to the correct sizes and shall be as indicated in drawing or as specified. All joinery work shall fit truly and without wedging or filling. All necessary mortising, tennoning, grooving, matching, tonguing, housing rebate and other necessary work for correct jointing shall be carried out in the best workmanship like manner. The frame work shall be made in required grid as specified in schedule item and in drawing. The frame work shall be rigidly screwed to the ceiling with 100 mm. long G.I. wood screws and rawl plugs @ 300 mm. centre to centre (or as specified) both ways by drilling holes in ceiling through frame work. The wood work shall be painted all over with fire resisting paint of M/s. Garware Paints Ltd. or any other approved equivalent make before erection of the same in position as per manufacturers specifications and as directed by Engineer-in-Charge.

If after fixing the frame work in position, any shrinking or substandard material or bad workmanship is detected, the contractor shall forth with remove them and replace the same at his own cost.

ii) **Sticking of insulation material & fixing of A.C./flexo board :** After fixing of the frame work as above, a thick coat of bitumen of approved grade shall be applied as vapour barrier in the grids of frame work and then fibre glass of required thickness shall be sticked to ceiling and panel of grids as directed by the Engineer-in-Charge. The panels of fibre glass shall be cut exact to grid size and evenly pressed.

Approved A.C./flexo board sheets cut to correct sizes as specified in item description shall then be placed on the frame works starting from the centre of the width and work side-wards. Holes required in A.C. sheet/flexo board shall be drilled and on no account holes shall be punched. A.C. sheet shall

be fixed to wooden frame work with suitable size of C.P. brass screws @ 300 mm. c/c. 4 mm. wide groove or as shown in the drawing shall be kept to correct line, level and plane at the junctions of sheets.

Any damage done to the finishes and to walls, columns, ceilings, plasters, floors etc. shall be made good to the original condition by the contractor at his own cost. The contractor should take protective measures during the progress of work. Cat ladders or roof boards scaffolding should invariably be used by men working on the thermal insulation work.

52.D-4 MODE OF MEASUREMENT :

This work shall be measured on square metre basis. The length and width shall be measured between plastered surfaces of walls upto two places of decimal of a metre for working out the area.

52.D-5 RATES :

Rates quoted by the contractor for the work shall include cost of all materials and labour required to complete the work as per item description, as per above specifications and as shown in the drawing.

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53. METAL FALSE CEILING SYSTEM & THERMAL INSULATION :

METAL FALSE CEILING SYSTEM (LUXALON 150 C / EQUIVQLENT):

53.1. MATERIALS

Manufacturing and Product: Hunter Douglas India Private Ltd. or equivalent

a) **PRODUCT :** Luxalon 150 C lineal aluminium false ceiling or equivalent

b) **COLOUR :** As specified or as approved by the Engineer-in-Charge

Material Description: All components shall be made of aluminium and manufactured by **M/s. Hunter Douglas India Private Limited OR Equivalent** and as per manufacturer's specification.

LUXALON 150 C METAL CEILING :

i) **PANEL:** The panel shall be cold roll formed panels 150mm wide and 15,5mm deep with a 5mm beveled edge creating an 8mm V groove made from corrosion resistant Al.-Mg. Alloy AA5050, The length of each panel shall be upto 6000mm. The aluminium panels shall be chromatised for maximum bond between metal and paint enameled twice under high temperature, one side with a full primer and finish coat in a polyester paint for a dry film thickness of 20 microns, the other side (inner side) with a primer coating and skin coat on a Continuous Paint Line.

ii) **CARRIER :** The carrier on which the panels shall be clipped on to will be 32mm wide, 39mm deep, made of black stove enameled 0.95mm thick aluminium alloy

AA5050. When two or more carriers are to be joined, they shall be joined together by means of splices, which will clip on to holes provided for the same.

iii) **WALL TRIM :** The wall trim shall be 15mm deep x 30mm wide x 15mm deep x 0.4mm thick Aluminium Alloy AA5050 with square edges and length of 5 mtr.

iv) **ROD HANGER :** The rod hanger of suitable length shall be made of 4mm dia. galvanised steel (Zinc coating 120 gms/Sqm.)

v) **SUSPENSION CLIP :** The adjustment suspension clip shall be made of galvanised spring steel V shaped with two holes to accommodate the rod hanger.

vi) **ANCHOR FASTNERS :** The single piece sleeve anchor with assembled hanger taper bolt and nut which has smaller driller dia. Anchor fastener shall be of arrow make or equivalent with thread size 5mm.

vii) **SUSPENSION SYSTEM :** The carriers would be suspended from the roof by 4mm dia galvanised (Zinc coating 120gms/Sqm.) steel wire rod hangers with height adjustment springs out of galvanised spring steel. Hangers shall be fixed to roof by 'J' hooks and Anchor Fasteners

53.2. FINISHING OF SURFACE OF STRIPS FOR INTERNAL USE (ALUMINIUM)

The coils from which aluminium panels are made shall be cold roll formed & stove enameled on a continuous coil coating paint line with dried in place roller coated application for pre-treatment. The coils to go through four stages of pre-treatment, three times oven baked through conversion coating, priming and finished coat, ensuring superior adhesion, high corrosion resistance and good colour retention. The coils shall be painted on both sides after being degreased. Prime coat of at least 5 microns to be applied on both sides and a back coat of 5 micron of neutral colour to be applied on the inside surface and 5 micron of binder and 15 microns of top coat of desired colour shall be additionally provided on the exposed surface.

Pencil Hardness. **:** phh > F

Light Fastness. **:** Light fastness of at least 6 according to international wool scale.

Colour Fastness **:** All finishes shall have a colour fastness of at least 6.

Colour Variation. **:** Colour diff, Bet batches + 4 units Colour diff. Within one batch + 2 units.

Colour Uniformity **:** Maximum allowable deviation is 2 NBS units.

Specular Glose. **:** 10 deg/00 (matt) ; 25 deg/00 (satin)

Resistance to Salt Spray **:** After 100 hrs testing under creep from the edges or the Cross, shall **Test** exceed 2mm. Blistering shall not exceed F 8.

Impact resistance : To withstand an impact test of 5mN/mm metal thickness Without loss of adhesion.

Paint adhesion. **:** Better than or equal rating 1

Humidity Resistance. **:** No formation of blister.

Chemical Resistance. **:** No loss of adhesion or gloss and no colour change or Staining.

53.3. FIXING : The panels shall be clipped on to a carrier. The carriers to be suspended with an adjustment spring of galvanised spring steel, V shaped with two holes to accommodate the rod hanger. The rod hanger to be made of 4mm dia, galvanised steel and suspended form the ceiling by J hooks fixed at 1.5mm centre to centre.

53.4. WORKMANSHIP : The ceiling shall be erected in continuous sequence. Spans would not exceed those recommended by M/s. Hunter Douglas India Pvt. Ltd. All work in this section shall be performed in an efficient manner by the installing agency approved by the manufacturers and as per manufacturer's recommended procedures.

53.5. FIRE RESISTANCE : The false ceiling including the paint shall be fire resistant as per DIN 4102.Class A2. It should also be classified as P-NOT EASILY IGNITABLE - AS PER BS 476. Part 6 and should have a fire propagation classification of Class as per BS 476. Part 6.

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53.6. THERMAL INSULATION

A. UNDERDECK INSULATION :

I. METHOD OF APPLICATION :

i) Clean the surface and make it free from dust and loose particles.

ii) Apply a coat of Shalicoat to the underside of the roof.

iii) Apply CPRX compound to the underside of each prelaminated Phenolic Foam panel and press the slabs in position. But the joints well together.

iv) Secure panel in position with the help of screws, rawl plug and washers.

v) Deal all the joints with the help of self adhesives Aluminium tapes

B. INSULATION ABOVE FALSE CEILING :

i) The insulation tiles shall be placed above the A1 carriers, which are a one meter c/c.

ii) The insulation tiles should be cut to the required size for placement over carriers as per the spacing and pattern of false ceiling lay out.

iii) The rate quoted shall be inclusive of cutting to the required size, wastage etc.

iv) The tiles shall abut each other to provide a continuous barrier for effective thermal insulation

GENERAL :

i. Extremely low 'K' value 0.018 Kcal/hrM.C.

ii. Low water vapour transmission level.

iii. Should be available in a single component system.

iv. Should be approved by both TAC and NIC.

v. Should be mildly antiseptic with resistance to fungal and bacterial growth and should not attract rodents / insects.

vi. Should have good acoustic properties.

vii. Temperature Range : + 125 degrees C to - 190 degrees C.

viii. Material shall be classified as P [not easily ignitable] - BS 476 Part 5.

ix. Material should conform to Building Classification "O" based on the propagation index BS 476 Part 6.

x. Material shall have a Class I surface spread of flame, the highest rating possible BS 476 Part 7.

xi. Lowest smoke obscuration 5% (almost negligible) - BS 5111 Part 1 .

xii. Toxicity index of 0.04478 - Naval Engineering Standards 713 (NES) Ministry.

54. WATER PROOFING :

GENERAL : The guarantee of minimum 10 years for waterproofing treatment in prescribed proforma must be given by the specialised agency which shall be countersigned by the contractor in token of his over all responsibility. The guarantee for waterproofing treatment in the prescribed proforma shall also cover Horizontal expansion joint and Vertical expansion joint. Waterproofing system shall be as per approved manufacturers specification .

54.1. WATER PROOFING PLASTER IN TOILET AREA :

The following specification shall be followed unless otherwise stated in schedule of quantities. This shall be 15 mm. thick plaster including an under coat not exceeding 8 mm. thick. Approved water proofing compound like CICO No. 1 or other approved equivalent shall be added @ 3% by weight of cement in cement mortar or as per manufacturers specifications in both the coats. The workmanship and material shall be same as described in plaster work in general. All exposed surfaces shall be finished smooth with a coat of neat cement as directed, except areas where tiling work is to be done, where the plaster shall be left rough / float finish..

54.2. BRICK BAT COBA WATERPROOFING ON TERRACE :

54.2.1. Materials : The aggregate for brick bat coba shall be broken from good and thoroughly well burnt bricks. These shall be strong, durable, clean and free from impurities. They shall not contain any soft or powdering materials. The aggregate shall be 20 mm. to 10 mm. size and shall be approved by the Engineer-in-Charge before use.

Lime to be used for preparing brick bat coba shall be of lime class B, conforming to I.S. 712-1959. Lime burnt from lime stone shall be used. All impurities, ashes or pieces improperly burnt shall be screened or picked out before slaking. It shall be in the form of lumps when brought to site of work and not in powder form. The lime shall not be slaked with water less than one week or more than two weeks before use.

54.2.2. Storage : The slaked lime if stored, shall be kept in a weather proof and damp proof closed shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it, and shall be approved by the Engineer-in-Charge.

54.2.3. Proportion : The proportion for brick bat coba shall be 0.906 cum. (about 32cft.) of brick bat to 0.34 cum. (about 12 cft.) of slaked lime.

54.2.4. Laying : The concrete surface shall be thoroughly rubbed, cleaned of all set mortar, all dirt and dust and slightly wetted. The brick aggregate shall be soaked in water before mixing with lime. The brick bat coba shall be laid in an even layer and to the required thickness and slope so as to form ridge, hip or valley line as may be necessary and as indicated in the drawing or as directed by the Engineer-in-Charge. The compaction shall be started immediately with wooden beaters and during the above process, the surface shall be constantly kept wet by sprinkling water observing the following precautions:

a) Brick bat coba shall not be rammed with heavy iron rammers as brick aggregates are likely to be crushed into powder thereby, but shall be beaten lightly and rapidly with wooden beaters to get the required compaction and to obtain complete integration of brick bats and lime.

b) While beating, fresh fracture may take place which may cause absorption of water from the mortar. Additional water may be sprinkled with beating in such cases as considered necessary by the Engineer-in-Charge. The beating work shall continue for at least 7 days.

c) The average thickness of coba shall be as specified in the items and the top of the coba shall be given slope or made level and edges taken into the brick masonry parapet or rounded off at junctions as shown in the drawing and as directed by the Engineer-in-Charge.

54.2.5. MODE OF MEASUREMENT :

The length and breadth of the surface area shall be measured to two places of decimals of a metre from the finished surface of wall and parapet and cubic contents to be worked out with average thickness of coba provided. Rate shall include cost of preparation of surface, cost of materials, labour, rounding of junctions etc. complete.

54.3. CHINA MOSAIC WATER PROOFING :

54.3.1. General : This type of water proofing shall consist of setting in thick cement slurry selected colour/white glazed tile broken pieces of approved make and size over 20mm. thick bedding of cement mortar 1:4 with approved waterproofing agent or as specified in schedule of work, to the required slope and level, over brick bat coba and finishing with neat cement and cleaning to the required degree of fineness and evenness.

The different materials and workmanship shall conform to the relevant I.S. specifications and shall be got approved before incorporating in the work.

The surface of brick bat coba shall be thoroughly cleaned of dust, dirt and loose particles removed and adequately watered. Thick coat of cement slurry of the honey like consistency shall be sprayed on the base before lime mortar screening of specified thickness is laid.

54.3.2. Laying : Over the prepared surface of brick bat coba, a layer of cement mortar, 20 mm. thick or as specified, shall be laid and cement slurry of consistency of honey, shall be spread over it using cement at a rate of not less than 0.01 cum. per 10 sqm. While the bed is fresh, broken pieces of 6 mm. thick selected white/colour glazed tiles not less than 25 mm. and not more than 50 mm. in any direction shall be set closely by hand at random. The glazed tile pieces shall be soaked in water before setting in position. The glazed surfaces shall be kept exposed and pressed with wooden mallet. Over the glazed tile pieces a neat cement slurry, using cement not less than 0.01 cum. per 10 sqm. shall be spread and the surface brushed in and lightly rolled with wooden roller, taking care that no air pocket is left between brick bat coba and china mosaic flooring.

The top surfaces shall be cleaned with saw dust and cotton waste. Finally the surface shall be cleaned with weak acid solution to remove cement marks over the white glazed tile pieces. The finished work shall be cured for at least 7 days. Care shall be taken to see that cement in joints does not get dissolved due to acid washing. At corners and junctions with parapet, the water proofing course shall be rounded off with cement mortar as per drawing and shall be included in the quoted rate.

54.3.3. MODE OF MEASUREMENT :

The length and breadth shall be measured to two places of decimal of a metre, along side the surface including rounding of junctions of walls and wall & slab etc. and area worked out in square metre. The rain water out-lets shall be finished as directed and no deduction shall be made for the same (area upto 0.02 sqm.) while arriving at the net area for payment.

54.4. TAR FELT WATER PROOFING :

54.4.1. General: All materials and workmanship for waterproofing the R.C.C. roof shall conform to I.S. 1346-1959 & 1322-1965 respectively. The tar felt shall be of type and of grade-I as specified in I.S. 1322-1965.

54.4.2. Preparation of Surfaces : The existing roof surface shall be prepared by cutting cracks if any to V section, cleaned and filled flush with cement sand slurry or a suitable grade of bitumen or both and the surface shall be allowed to set and dry. The surface of the roof and that part of the parapet and gutters drain mouths etc., over which the waterproofing treatment is to be laid shall be cleaned of all foreign matters viz. fungus, moss, dust etc. by wire brushing and dusting.

54.4.3. Laying : The felt shall be laid in lengths at right angles to run off gradient commencing at the lowest level and working upto the crest, thus providing adequate overlap of the adjacent lower felt.

The bituminous primer shall be brushed @ 0.42 ltr./sqm. (1 gallon/100 sft.) over the roof surface thus prepared and allowed to dry. The bitumen bounding material (60/70 grade) shall be prepared by heating to the correct working temperature and conveyed to the point of work in a bucket or pouring cane.

The felt shall be first cut to required length, brushed clean of dusting material and laid out flat on the roof to eliminate curls and subsequent stretching. Each length of the felt prepared for laying as described shall be laid in position and rolled up for a distance of half of this length. The hot bonding material shall be poured on to the roof across the full width of the rolled felt @ 1.2 kg/sqm. as the latter is steadily rolled out and pressed down. Light rollers as required on the work shall be used to even up the treatment at the contractors cost. The excess bonding material is squeezed out at the ends and is removed as the laying proceeds.

When the first half of the strip of felt has been bonded to the roof, the other half be rolled up and unrolled on to the top bonding material in the same way. Minimum overlaps of 10 and 7.5 cm. shall be allowed at the end and sides of strips of felt. All overlaps shall be firmly bonded with hot bitumen.

After the specified number of layers of felt have been laid, hot bitumen (60/70 grade) shall be applied over the top surface @ 1.2 kg/sqm. Pea size gravel as mentioned in item description shall be uniformly spread on this hot bitumen layer @ 0.0609 cum. to 0.0761 cum./10 sqm. (2 to 2.5 cft. per 100 sft.) on horizontal surfaces and over the rounded junctions, a coat of cement slurry shall be applied and grit shall be pressed into the slurry coat followed by curing.

For flashing in existing parapet walls, a groove or chase at a minimum height of 15 cm. above the roof level shall be cut in the vertical face of the wall and shall be filled with cement mortar 1:3 after water proofing compound is thoroughly set. This groove shall be of dimension 7.5 cm. wide and 6.5 cm. deep. In case of low parapet where the height does not exceed 45 cm., grooves

shall be provided and water proofing treatment shall be carried right over the top.

Felt shall be laid as flashing in widths wherever junction of vertical and horizontal structures occur with minimum over lap of 10 cm. The lower edge of flashing shall overlap the felt laid on flat portion of the roof and the upper edge of the flashing shall be taken along the entire vertical face of the tucked groove made in the parapet and over the top surface so as to provide a continuous water proof layer. Each layer shall be so arranged that the joints are staggered with those of the layer beneath it.

Drain mouths, gutters, drain outlets, projections, pipes etc. shall be given the special treatment conforming to I.S. 1346 - 1959.

54.4.4. Guarantee : The contractor shall furnish guarantee as per appendix D for maintaining the roof leak proof for a minimum period of 10 (ten) years. If any defects occur during guarantee period, the contractor shall rectify the same within three days of intimation at their own cost to the satisfaction of the Engineer-in-Charge. The decision of the Engineer-in-Charge shall be final and binding.

The tenderers may, if they so desire, quote on the basis of their own patent water proofing treatment with rates and terms and conditions if any and detailed specification if their patent treatment is considered by them to be more effective and competitive. They shall also guarantee their treatment for a minimum period of 10 (ten) years.

54.4.5. MODE OF MEASUREMENT : Only plan dimensions between brick / concrete walls shall be measured in sqm. to second place of decimal for payment. Rainwater outlets shall be finished as directed and no deduction shall be made for the same (area upto 0.02 sqm.), while arriving at the net area for payment. The rate shall also include rounding of junctions between walls / wall & slab.

54.5. CEMENT BASED WATER PROOFING OF W.C. AND BATHS AREAS :

54.5.1. General : The water proofing treatment for the Bath and W.C. shall be essentially of cement based water proofing treatment with admixture of proprietary water proofing compound similar to M/s. India water proofing companys treatment or any other equivalent approved cement based water proofing treatment. The waterproofing treatment shall consist of providing cement slurry mixed with proprietary water proofing compound after preparation of surfaces, providing water proofing cement plaster, finishing smooth/rough as required to the required line, level, curing, finishing, guarantee for the water tightness of the water proofing treatment etc.

54.5.2. Preparation of Surface : The surface to receive water proofing treatment shall be thoroughly cleaned of scales, laitance, set mortar etc. for receiving water proofing treatment, and necessary preparation of the surface for providing water proofing treatment shall be done by the contractor. If any honey combs are observed in beams and slabs of Bath and W.C., the same shall be grouted with cement slurry mixed with water proofing compound and

the cracks and crevices, filled with injection method.

54.5.3. Sequence of Treatment : All cutting and chasing in the floor and walls for plumbing work shall be done by the plumbing agency. Water proofing agency shall then provide CETROOF or equivalent approved cement based water proofing treatment consisting of cement plaster treatment mixed with the water proofing compound according to the recommended specifications of the waterproofing agency. The thickness of water proof plaster shall be about 35 mm. on floor area of the depression and about 25 mm. thick on the vertical surface of walls/concrete surface in case of sunken slabs, upto the finished floor level. The thickness shall be about 18 mm. for the remaining wall height upto 600 mm. from finished floor level.

The plumbing agency shall then lay and fix the pipes, W.C. pans, traps etc. without disturbing the water proofing treatment. However, the joints of water supply and waste connections including holes drilled for clamps shall be treated by water proofing agency.

Waterproofing agency shall then fill-in the depression in the floor with their 'CETROOF'or equivalent approved waterproof brick bat coba with the admixture of waterproofing compound according to waterproofing agency's specification and process, which should be furnished in writing to the Engineer-in-Charge for effective supervision of completeness of the process while executing the works.

54.5.4. Finishing : The surface of the exposed plaster shall be finished smooth with neat cement. The plaster surface where tiling is to be provided as well as brick bat coba filling where flooring to be provided, shall be finished to proper line, level, plane and plumb to receive the floor/dado finish. Curing of the waterproofing treatment shall be carried out for 14 days.

54.5.5. Testing and Guarantee : The contractor shall test the surface where waterproofing treatment is provided for the bone dry condition by filling with water inside the depressed plastered portion. No wet patches or leaks shall appear on he surrounding plastered walls or at the under side of the slabs. The testing shall be carried out to the entire satisfaction of the Engineer-in-Charge. The contractor shall furnish guarantee in the Proforma as per Appendix D for the waterproofing treatment for maintaining the under side of the waterproofed surface in bone dry condition for a period of minimum ten years. During this period, contractor shall attend to all leakages, defects etc. if noticed, free of cost, starting his work of checking up and rectification with in a weeks time from the date of receipt of information about such leakages etc. by him.

The contractor shall submit the guarantee bond on appropriate stamp paper and as per the enclosed proforma.

54.5.6. MODE OF MEASUREMENT :

i. Waterproof plaster shall be computed by taking the length and breadth of the area actually plastered correct upto two decimal places of a metre. No deduction shall be made for W.C. pans, pipes etc. in the measurement.

ii. The filling with waterproof brick bat coba shall be computed by noting the levels and dimensions of the filled up depression before and after the filling, upto two decimal places of a metre and also no deductions shall be made for W.C. pans, pipes etc.

54.6. CEMENT BASED WATERPROOFING OF ROOF TERRACES :

54.6.1. General : The waterproofing treatment shall be essentially a cement based waterproofing treatment similar to that of M/s. India Waterproofing Companys CETROOF or any other equivalent approved waterproofing treatment. The waterproofing treatment shall consist of providing cement slurry mixed with waterproofing compound, at desired proportions including grouting the cracks and crevices with cement slurry mixed with waterproofing compound, laying brick bats over cement mortar bedding to the required slopes for roof drainage, filling and grouting the joints with cement mortar, finishing the surface smooth/chequered with cement plaster mixed with waterproofing compound etc. as directed.

54.6.2. Preparation of Surfaces : All the rubbish, debris and other materials left over by other agencies will be got removed by the Contractor through other agencies. After removal of this rubbish, debris etc., the surface to receive the waterproofing treatments shall be thoroughly cleaned with wire brushes including removing of scales and laitance, set mortar etc. by the waterproofing contractors. If any honey combing including cracks and crevices are observed at column junctions/and elsewhere, the same shall be grouted with cement slurry mixed with approved waterproofing compound.

54.6.3. Treatment : The waterproofing treatment shall be generally as per manufacturers own specifications, method and procedure. A typical cross section of the waterproofing treatment shall generally consist of the following:

i) Applying cement slurry mixed with waterproofing compound for the entire surface to be treated.

ii) Laying of broken brick bat of required thickness over cement mortar bedding to give proper roof drainage, grouted with cement mortar with waterproofing compound.

iii) Laying of jointless cement based waterproofing cement mortar layer of average thickness as specified in the item.

iv) Final rendering to give a smooth finish of cement colour with false lines at 300 x 300 mm. or nearer convenient dimensions. Tenderer shall give complete details of waterproofing treatment proposed by him, in writing viz. details including roof fill material, waterproofing compound, minimum and maximum thickness etc. for effective supervision of the EIC/Representative Engineers, while the work is executed at site.

The contractor shall ensure that sufficient slope for effective roof drainage is provided within the average thickness of waterproofing treatment proposed by the contractor. In case the average specified thickness of treatment exceeds, the fact shall be specifically brought to the notice of the Engineer-in-Charge, before adopting the extra thickness.

The rain water down take pipes if any, shall be fixed by the other agency prior to commencement of waterproofing operation. Curing of the finished surface by ponding shall be done for 7 days atleast.

54.6.4. Testing and Guarantee :

The contractor shall test the surface for the bone dry condition by ponding water over roof for minimum seven days period to the entire satisfaction of the Engineer-in-Charge. Alternately, the curing of the finished surface done by ponding of water on the entire surface for seven days, can also be used for testing water tightness. After a period of two months, once again the roof should be ponded with water to check its efficiency of waterproofing treatment against leakage. The contractor shall furnish guarantee in the proforma as per Appendix D for the waterproofing treatment provided by them, for maintaining the under side of the roof in bone dry condition for a minimum period of ten years.

During this period, the contractor shall be liable to attend all the leakages, defects etc. if noticed, free of cost, starting his work of checking and rectifications within a weeks time from the date of receipt of intimation of such leakages etc. by him.

54.6.5. MODE OF MEASUREMENT :

Net area in square metre of the roof measured in between the side walls, i.e. plan dimensions including rounded junctions, kerbs, parapets where waterproofing treatment provided etc. shall be measured for payment. No deduction shall be made for openings upto 0.02 sqm such as rain water outlets etc., but the same shall be finished as directed by the Engineer-in-Charge. The rate shall include the cost of labour, materials, scaffolding etc. and shall cover the cost of rounding of junctions etc. which will not be measured separately. Brick bat filling done under this item will not be measured separately and is deemed to be included in the waterproofing treatment for roof with an average thickness of 115 mm.

54.7. INTERNAL WATERPROOFING FOR OVERHEAD WATER TANK / LIFT PIT / UNDERGROUND SUMP OR TANKS :

54.7.1. General : The waterproofing treatment for overhead water tanks shall be essentially a cement based waterproofing treatment similar to that of M/s. India Water Proofing Company, consisting of providing water proof cement plaster after preparing the surface, filling the cracks and crevices by means of injection and surface method, using proprietary waterproofing compound as per their own specifications and as per recommended proportions etc. and testing of watertightness of the water proofing treatment and furnishing guarantee as specified.

54.7.2. Preparation of Surfaces : The surface to receive the waterproofing treatment shall be thoroughly cleaned of scales, laitence, set mortar etc. The surface shall be roughened with close hacking to provide adequate key for the waterproofing treatment. All honey combs in concrete surface shall be carefully hacked and loose materials removed and all pockets plugged suitably well before commencing waterproofing treatment.

54.7.3. Treatment : Before any work of waterproofing is taken in hand, all the surface preparation mentioned above shall be got approved from the Engineer-in-charge. All plumbing work will be got completed by the contractor before commencing the treatment.

The treatment shall then be commenced with injection into RCC members wherever required by cement slurry mixed with water proofing compound of appropriate consistency to fill up all cracks and crevices if any. A layer of waterproofing plaster in the specified proportion as per manufacturers/waterproofing contractors recommendations with admixture of approved manufacture waterproofing compound, shall then be laid over floor from inside and will be continued along the sides and partition walls to their full height. The thickness of this treatment on the floor shall not be less than 50 mm. and that on walls not less than 20 mm. The entire surface shall be finished smooth with steel trowel in cement colour. The plastered surfaces shall be kept continuously wet immediately after 24 hours so as to cure it properly for at least seven days.

54.7.4. Testing : The tank will thereafter be got filled upto the full height immediately by the Contractor as specified, and water stored for a minimum period of seven days so as to observe any leakages/defects for necessary compliance by the waterproofing contractor.

In the case of tanks whose external faces are exposed, the requirements of the test shall be deemed to be satisfied in the external faces shown no sign of leakage and remain apparently dry over the period of observation of seven days after allowing a seven days period for absorption after filling the tank for full height. If the structure does not satisfy the conditions of test, the period of test may be extended for a further period of seven days and if specified limit is then reached, the structure may be considered a satisfactory. Suitable remedial measures shall be taken by the contractor at his own cost till the test as specified above is carried out satisfactorily.

In the case of tanks whose external faces are exposed or can be left exposed prior to testing all leakages, wet patches and the like, shall be marked out on the outside of walls during test. The tank shall then be dewatered and the defects made good by grouting, waterproofing, plastering etc. as necessary to the entire satisfaction of the Engineer-in-Charge, at no extra cost . The tank shall again be tested for leakage after rectification. The work shall not be accepted unless the water tightness is established.

Back filling in case of underground sump and waterproofing the roof where specified, shall be carried out after testing and rectification of defects. The completion certificate shall not be given unless the test for water tightness as

described above is carried out to the entire satisfaction of the Engineer-in-Charge. After a period of two months after the tank is left dry, once again the tank should be filled with water to check the efficiency of the waterproofing treatment done. If there is any leakage or wet patches, the same shall be rectified, with no extra cost, by the contractor.

54.7.5. Guarantee : The contractor shall furnish service guarantee in the prescribed proforma vide Annexure 'D' of the Tender for the workmanship and the materials provided and for maintaining the waterproofed surfaces of the tanks in bone dry condition for a minimum period of ten years. If any defect occur during the guarantee period, the contractor shall rectify the same at his own cost to the satisfaction of the Engineer-in-Charge, and start his work of checking and rectification within seven days after receipt of intimation by him.

54.7.6. MODE OF MEASUREMENT :

Measurement for payment of waterproofing treatment shall be as per actual area covered by waterproofing treatment including offset, overlapping, rounded junctions, haunch etc. as provided at site. The length and breadth of the surface actually treated with water proofing treatment shall be measured upto two places of decimal of a metre. No deduction shall be made for inlet, outlet, scour connection, but the same shall be finished as required. The rate quoted shall include all the cost of materials, labour, transportation, testing of water tank for water tightness, furnishing necessary guarantee for waterproofing so provided, all as detailed above.

54.8. WATER PROOFING TREATMENT OF EXPANSION JOINT AT ROOF LEVEL :

54.8.1. Treatment : The expansion joint treatment at roof level shall be provided with approved cement based waterproofing treatment of M/s. India Water proofing Company or other approved equivalent waterproofing agency. This treatment shall be 20 mm. thick waterproof plaster on top sides and ends of RCC covering hood over expansion joint as shown in the drawing.

54.8.2. Guarantee : The contractor shall carry out the test for waterproof joint provided for expansion joint at roof level by any approved method and furnish a guarantee for the watertightness of the joint in the prescribed proforma as per Appendix D and its maintenance in bone dry condition for a period of ten years. During this period the contractor shall be liable to attend to leakages, defects etc. noticed, free of cost within a weeks time from the date of intimation to him of such leakages.

54.8.3. MODE OF MEASUREMENT :

The measurement for the joints thus waterproofed, shall be made in Running Metres upto two places of decimal of a metre.

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55. INTEGRAL CEMENT BASED WATER PROOFING TREATMENT OF UNDER GROUND WATER TANKS, SWIMMING POOLS, BASEMENTS ETC. FROM OUTSIDE:

55-A. ON HORIZONTAL SURFACES

55-A-1. Preparing the Surface

The water proofing treatment over the lean concrete/levelling course surface should adhere to the surface firmly. The surface of levelling course should be roughened when the concrete is still green. In case the surface is not made rough in the initial stages itself (i.e. before the concrete is set, the work of water proofing shall not be permitted till proper key is provided for the 25 mm thick base layer. This key cannot be achieved by hacking the already set concrete surface, instead a spatter-dash key should be provided without any extra cost, as it is the responsibility of the contractor to roughen the surfaces properly over which plaster or similar coat is to be laid.

55-A-2. Blending Cement/Water with Water Proofing Compound

Mixing water-proofing compound in powder or liquid form, to already prepared cement mortar shall not be allowed. **Blending Cement** with water-Proofing Compound shall be prepared as followed:

i. The required quantity of cement bags to be used for a particular portion of work should be sorted out and the contents of each bag should be emptied on a suitable dry platform. Water proofing compound in powder form manufactured by reputed approved manufacturer, bearing ISI mark, conforming to IS 2645 should be mixed with the contents of each bag. The quantity of water proofing compound to be mixed should be as prescribed by the manufacturer but not exceeding 3% by weight of cement.

ii. The quantity of cement (50 kg) and water-proofing compound in powder form should be mixed thoroughly, blended by employing skilled labourers and the cement thus blended should again be packed in gunny bags so that the material can be readily used for preparing mortar/slurry for the water proofing works, to achieve best results.

Note: Unless otherwise specified, all waterproofing works shall be carried out using blended / PPC cement.

55.-A-3. Blending Water with Liquid Water Proofing Compound.

(i) In case the water proofing compound to be used is in liquid form then instead of blending cement with water-proofing compound the water to be used in the particular mix should be blended with water proofing compound.

(ii) This shall be done by taking just required quantity of water to be mixed in the particular batch of dry cement mortar. The required quantity of water thus collected per batch of dry cement mortar to be prepared should be mixed with liquid water-proofing compound from sealed tins with ISI mark and manufactured by reputed approved manufacturer.

(iii) The water thus mixed with water-proofing compound shall be stirred so that the water is blended with water proofing compound well.

(iv) The quantity of blended water thus prepared should only be used per batch of

dry cement mortar/dry cement to make slurry to be used for water-proofing works to achieve the best results.

Note: Use of cement mixed with water-proofing compound is referred as "blended cement" in this chapter which shall mean use of water proofing compound in powder/liquid form for use in cement mortar/slurry.

55.-A-4. Rough Shahabad stone:

i. The stone slabs to be used for this item shall be carefully selected for uniform thickness. Stones with varying thicknesses shall not be permitted to be used. Unless otherwise specified, the size of rough Shahabad stone shall not be less than 300x300mm and thickness 22mm (+/-) 3mm.

55.A.5: Preparation of Cement Slurry

Cement slurry normally prepared and used on general building works with just 1.50 to 2 kg of cement to cover an area of one sqm shall not be applicable for such works instead it should have thick honey like consistency. Each time only that much quantity of slurry shall be prepared which can be covered on the surface and the surface in turn would be covered with 25 mm thick cement mortar base within half an hour. Slurry prepared and remained un-used for more than half an hour shall be totally rejected.

55.A.6. Preparation of Cement Mortar

The cement mortar 1:3 (1 blended cement : 3 sand) shall be prepared with cement / water duly blended. Each time only that much quantity of cement mortar that can be consumed within half an hour, shall be prepared. Any quantity of cement mortar that is prepared and remains unused for more than half an hour shall be totally rejected.

55.A.7. Laying Water Proofing Course

1. First layer : 25 mm thick Base Course in Cement mortar 1:3

i. Before laying the first course of cement mortar 1:3 base the lean concrete surface shall be cleaned neatly with water and cement slurry shall be applied only on the area of the concrete surface, that can be covered with the cement mortar (1:3) base course within half an hour.

ii. The cement slurry should cover every spot of the surface and no place shall remain uncovered.

iii. Just after the application of cement slurry on the surface, the cement mortar should be used for laying the base course.

iv. For laying base course to a perfect level at least 3 Nos. 25mm high wooden strips with 3 legs shall be placed on the concrete surface at suitable distances and the cement mortar shall be laid to the exact level of the strips and tamped gently. The top surface should be finished neatly and later scratched when green with a suitable instrument.

v. Before the base course dries and gets hard that is just before the base course takes up initial set, the 2nd layer of Shahabad stone/slab cladding shall be taken up immediately.

Note : As far as possible work of different layers of this water proofing treatment shall be taken up in immediate succession without allowing any time gap in between the layers, otherwise it would be difficult to achieve homogenous treatment, which is the basic necessity.

2. Second layer : Shahabad stone.

i. When the 25 mm thick base course is just getting set the cement slurry should be spread over the base course up to the area that shall be covered with just two to three stone slabs.

ii. The Cement slurry shall be spread in such a way that the area of base course to be covered immediately shall be covered with slurry without any gap, or dry spots.

iii. Each time only the area that is required to clad two to three stone slabs shall be taken up for spreading the slurry and only after fixing the stone slabs over the slurry further area shall be taken up.

iv. Immediately on applying cement slurry on the base course the Shahabad stone slabs shall be laid over the base course and pressed gently so that the air gap can be removed.

v. The slurry applied on the surface which gets spread when the stone slab is pressed shall get accumulated in the joints of adjacent stone slabs and if any gap still remains between the stone slabs the same should also be filled with additional quantity of cement slurry.

vi. For laying the stone slabs in perfect level, two slabs at adjacent corners/ends shall be fixed firmly to the required level and a string stretched over the two slabs, the intermediate slabs shall then be set to the level of the string.

3. Third layer : 25 mm thick course in cement mortar 1:3

i. On filling all the joints of the Shahabad stone slabs with cement slurry and after a gap of 6 to 8 hours the area of stone slabs shall be cladded with cement mortar 1:3.

ii. The surface of stone slabs shall be cleaned and lightly watered. The cement mortar (1:3) shall be used for laying this course, no cement slurry need be used and the mortar can be laid on the slab surface directly.

iii. For laying this course in perfect level, 25mm high wooden strips with legs used for laying base course shall be used and the top surface shall be finished smooth without using additional cement or slurry.

4. Fourth Layer : Top Finish with Stone Aggregates 10 to 12 mm Size

i. Immediately after laying 3rd course and before the cladded mortar takes the initial set, stone aggregate of 10mm to 12mm nominal size shall be pressed into the finished surface @ 8 cudm/sqm.

ii. The aggregates though embedded shall be clearly visible on the surface, i.e. the stone aggregates shall not be embedded totally inside the mortar.

Note: This treatment is provided over the surfaces which are originally in slope or in level & no attempt under any circumstances shall be made to provide any slope by altering the 25 mm thickness of base course, to lay the water-proofing course in slope.

In case a slope is to be provided for the water proofing layer on a surface which is in perfect level, grading with additional cement concrete/cement mortar shall be provided and then the water-proofing layer shall be laid on the graded surface.

55.A.8. Curing

a) Water Proofing on Lean Concrete Surface

Immediately after completing the fourth layer, arrangements shall be made to lay the top RCC slab as quickly as possible and in the mean time till the top slab is concreted the water proofing treatment shall be kept wet continuously. In case the concreting of slab gets delayed for more than 2 weeks the curing can be stopped after 14 days.

b) Water Proofing on Horizontal Surface of the offset of floor slab.

The water proofing treatment done on the offset of the floor slab shall be kept wet continuously for 14 days minimum.

55.A.9. Measurement: Length and breadth shall be measured along the finished surface correct to a cm and area shall be worked out to nearest 0.01 sqm.

55.A.10. Rate: The rate shall include the cost of labour & materials involved in all the operations described above.

55-B. ON VERTICAL SURFACES

The vertical water proofing treatment either from inside or outside shall be undertaken only when the entire work is structurally complete.

55.B.1. Preparing the Surface and Providing Ancillary Arrangements.

(i) The surface of the structure to be treated shall be roughened properly either by raking joints when the mortar is still green in case of brick/stone masonry structures, or by hacking the cement concrete surface with a specially made hacking tool just after removing the shuttering.

(ii) In case the raking joints/hacking concrete surface is not done properly

the only alternative method to make the surface rough by **"Spatter dash key"** (a special hacking tool), which shall be done by the contractor without any extra cost.

(iii) For doing the water proofing treatment from outside or inside, al-round scaffolding shall be erected which shall be strong enough to support the stone slabs . Also proper strong scaffold boards, strong ladders and coir ropes shall be made available for using while erecting the stone slabs. Similarly, while doing the water proofing to vertical faces from inside, a particular care shall be taken to see that the water proofing layer of floor slab is not get damaged while resting the vertical props of scaffolding. As a precaution it is advised to rest the bellies on the strong and proper size sole piece placed on the horizontal water proofing treatment of the floor slab.

(iv) Alternatively water proofing for vertical surface shall be provided before horizontal floor slab water proofing. In order to arrest any leakage through junction of vertical/horizontal water proofing, a proper haunch in cement concrete shall be provided.

(v) For the stone slabs that are used for arresting the leakages, while executing this type of water proofing treatment, the first and foremost mandatory condition is that the number of joints in the portion covered by the stone slabs shall be minimum and this condition can be achieved only by using the maximum possible size of stone slabs. Normally the size of stone slabs used for the purpose is 600 x 600mm x 900mm each stone slab weighing approximately 16 kg and 25 kg respectively.

(vi) The Rough Stone slabs used for such works though are basically rough on the surface still that much roughness will not be sufficient for the stone slabs to remain in vertical position held by cement slurry. Therefore the grip for the stone slabs has to be increased and this can easily be done by planting 12mm to 15mm nominal size stone aggregate fixed with araldite on the face of each stone slab.

(vii) A 20mm thick clear gap has to be formed between the masonry/concrete surface and the stone slabs erected in vertical position for pouring the cement slurry. This gap can be maintained by fixing with araldite the 20mm x 20mm cover blocks made out of M50 or more Grade of concrete on the four corners of the stone slabs and also at centre.

55.B.2. Preparation of Cement Mortar (1:4)

Cement mortar shall be prepared as explained above except that the proportion shall be 1:4 (1 Blended Cement : 4 Coarse sand) instead of 1:3.

55.B.3. Fixing Water Proofing Courses on Vertical Surfaces.

Note:

(i) Normally the item of work prescribes executing the first layer as base course with Cement slurry, second layer fixing rough Shahabad stone slab, third layer as plastering the surface and the fourth layer as finishing surface with

neat cement punning, but in actual execution, a gap of 20mm width has to be formed for pouring cement slurry. The 20mm wide gap can be formed by erecting the 20 mm thick Shahabad slab at a distance of 20 mm from the Masonry/concrete surface, over which the cement slurry is to be cladded and can be termed as first step for construction.

(ii) Hence for all practical purposes, chronology of layers shall be considered as per actual construction i.e. as laid in particular serial and not as actually formed later. To avoid confusion and to distinguish between the two different layers laid and the actual work executed, actual working is termed as Step I, Step II etc.

Step I: Erecting Shahabad Stone Slab forming 20mm wide gap.

(i) The Shahabad Stone slab duly fixed with 20 x 20 mm cover blocks and 12 to 15mm size stone aggregate on the surface shall be erected against the masonry/concrete surface to be treated by abutting the 20mm thick cover block against the surface, thus forming a clear gap of 20 mm.

(ii) The stone slabs thus erected shall be supported with ballies/pipes to the scaffolding already erected for the purpose.

(iii) The joints of stone slabs shall be temporarily closed from outside with cement mortar so that the cement slurry poured in the gap does not escape through the joints. The bottom portion of the stone slabs shall also be closed with cement mortar.

(iv) While erecting the stone slabs, proper care shall be taken to see that stone slabs are of uniform size. In case similar width slabs are used, it shall be ensured that these are not fixed at the corners but the same should be at the middle portion.

(v) Interlinking of the Shahabad Stones of horizontal layer of water proofing with this vertical layer of water proofing shall be done very carefully, as per standard practice.

(vi) The Stone slabs shall be erected in perfect plumb and fixed in position and it will be considered as 2nd layer of water proofing on completion.

(vii) Further lifts of Shahabad Stone slabs up to the full height of the masonry/ concrete wall shall be erected only after filling the gap of each lift erected, with cement slurry.

Step II : Filling Cement Slurry in the gap formed by erecting Shahabad Stone Slabs:

(i) When the first lift of stone slabs are erected and checked to be in perfect plumb, cement slurry shall be poured in the gap till the gap is filled completely.

(ii) The further filling of slurry in the second lift shall be done when the second lift of stone slabs are erected in position and thus the work on 2nd and 1st layer of the item shall be completed simultaneously till the cladding over the

entire height of the wall is complete.

(iii) Thus on completion of filling cement slurry and erecting stone slabs for the entire height of the wall, it can be considered that the first layer (i.e the layer of cement slurry) and the second layer (i.e. the layer of erecting Rough Shahabad Stone Slabs) is complete as per the item.

Step III : 3rd Layer: Plastering Over 2nd layer with Cement Mortar 1:4 (1 Blended Cement : 4 Sand)

i. Immediately on completion of the work of cladding the entire masonry/ concrete wall with Shahabad Stone slabs, the cement mortar applied over the joints shall be removed and the joints exposed. The entire surface shall be cleaned with water neatly to start the plastering work.

ii. Cement mortar 1:4 (1 blended cement : 4 coarse sand) shall be used for the purpose. Care shall be taken to see that the 20mm thickness of cement plaster over the entire surface is maintained correctly.

iii. The work of plastering shall be taken up immediately on completion of cladding the wall surface, rather it should be a continuous process from the day of starting the erection of stone slabs till the finishing work of plastering is done.

iv. The plastering shall be done from top to bottom without leaving any joint. As far as possible the joints in plaster shall be minimum. In case a joint has to be left to continue the work on the subsequent day, cement slurry shall be applied over the entire joint, and then only the further work of plastering shall be taken up.

Step IV: 4th Layer: Finishing with Neat Cement Punning:

(l) When the surface of plastering is still green, the cement slurry shall be applied over the plastered surface and the surface shall be finished neatly to a smooth surface with specially made semi rounded thapis. The surface should show a smooth and neat finish without any undulations.

55.B.4. Curing and Testing: On completion of water proofing course from outside, the tank shall be cleaned from inside, scaffoldings shall be removed and tank is gradually filled with water for testing, which shall commence within two or three days. The exposed faces of the water proofing course shall be kept wet for 14 days. No back filling shall be done before expiry of 14 days from the date of completing the water proofing course from outside.

55.B.5. Measurement: Length, width/height shall be measured along the finished surface correct to a cm and the area shall be worked out correct to nearest 0.01 sqm.

55.B.6. Rate: The rate shall include the cost of all labour and materials involved in all the operations described above and for all heights.

55-C. The only difference between treatment of horizontal and vertical surfaces is the thickness and the type of treatment per layer that is to be provided. The

same is tabulated below for clear understanding:

Horizontal Surfaces			Vertical Surfaces		
Layers	**Details of Layer**	**Thicknes**	**Layers**	**Details of**	**Thicknes**
First Layer	25mm thick base course	25mm	First layer	Base course with	20mm
Second Layer	Shahabad Stone Slab	22(+/-)	Second Layer	Shahabad Stone	22(+/-)
Third Layer	Finishing with CM 1:3	25mm	Third Layer	Plastering II Layer	20MM
Fourth Layer	Embedding 10 to 12mm	----	Fourth Layer	Punning with neat	---
	Total Thickness	**72 (+/-)**		**Total Thickness**	**62 (+/-)**

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56. EXPANSION JOINTS :

56.1. SCOPE OF WORK :

The work contemplated under these specifications consist of supplying the expansion joint fiber boards, sealing compound, aluminium plates etc. strictly as per these specifications and relevant drawings.

56.2. MATERIALS :

Materials for expansion joint filler boards shall be of best quality bitumen impregnated performed non-extruding, resilient type of specified thickness in the standard sizes available.

The sealing compound to close the gaps at the edges shall be of best quality rubberized bituminous hot pour, made from special grades of bitumen and shall not show flowing tendency in hot weather and is resilient in the cold weather. The liquid primer shall be made from blown grade bitumen of approved quality.

The aluminium plates for fixing at floor level shall be of specified size and out of extruded sections, free from any rolling defects.

The aluminium sheet for fixing at bottom of beams or sides of columns shall be of specified size without any defects.

56.3. PREPARATION OF SURFACES :

All the concrete surfaces already cast and where the expansion joint is to be formed, shall be properly cleaned off all dirt, mortar/concrete sticking, dust etc. One coat of primer shall be applied by brush to the entire concrete surface, just prior to the next concreting.

56.4. WORKMANSHIP :

Soon after the primer is applied, the filler board shall be placed at the side and held tight with the concrete surface, by suitable means. Care shall be taken that the boards do not get damaged or warped during all the operations. Utmost care shall also be taken to ensure that the board is held tightly to the concrete surface and no stone chip, concrete etc. is allowed to splash between the board and the existing concrete surface against which the board is placed.

After the deshuttering, the surface shall be cleaned off all grit, mortar, cement plaster etc. and edges filled with the sealing compound, and properly pressed to render smooth and uniform surface.

If desired by the Engineer-in-charge, the aluminium plates/sheets of specified thickness and sizes shall be fixed to under side/above beams. The plates shall have round holes at 300 mm. c/c. of required diameter on one side of joint through which screws shall be fixed into the concrete. On the other side, slotted holes at 300 mm. c/c shall be provided so that when screwed, these shall render smooth movement of plates during expansion/contraction. The plates shall be fixed correctly to required level, line, plumb etc. and as directed by the Engineer-in-charge.

In case of plates fixed on floors, they shall be fixed when floor mortar screed is laid to required level over the expansion joint duly filled up with sealing compound.

In case of roof, the expansion joint in beams placed vertically, shall be extended upwards, when RC/Brick masonry curbing is laid to the desired height (approximate 450 mm.) over which horizontal flat board is laid to the extent of 150 mm., or so as shown in drawing as per procedure laid down here- in- before.

56.5. MODE OF MEASUREMENT :

Unless otherwise mentioned, all the vertical and horizontal expansion joints in columns and beams shall be measured in a net area in sqm. Actually laid at site. The length and breadth shall be measured correct upto half centimeter. The aluminium plates/sheets shall be measured in running metres correct upto half centimeter, the width being specified in the item.

The rate shall include the cost of all materials, labour, transport, making holes in plates, grouting, making good the surface etc. all operations required to complete the job.

* * * *

57. RAILING, BALUSTERS AND NEWELS :

57.1. SCOPE OF WORK AND GENERAL : The item refers to supplying and fixing in position composite hand railing for staircase, open area, balcony, corridor etc. at different floors, levels and locations.

57.2. MATERIALS : The class and quality of wood to be used for hand railing and workmanship shall comply with the requirements specified in wood work wrought and put up and also comply with the I.S. specifications. M.S. balusters, grills, M.S. flat frame work and runners to be used in hand railing, their quality, workmanship etc. shall comply with requirements specified in manufacture of M.S. grills, and

standard practice adopted in fabrication of structural steel work and also comply with I.S. specification.

57.3. SAMPLES : Before taking up fabrication and erection on mass scale, the sample of railing materials being used etc. shall be got approved by the Engineer-in-charge.

57.4. FABRICATION : The fabrication of wooden hand rail shall follow the standard specification for wood work. The wooden handrail shall be in single piece per flight panel, moulded, shaped and finished to required dimensions as shown in drawing and as directed by the Engineer-in-charge. The hand railing shall be secured perfectly to line, slope and level to M.S. flat runners, balusters, newels and posts. M.S. grill, balusters, M.S. flat frame work fabricated as per the drawing and shall be strictly according to the specifications specified in manufacturing of M.S. grills and structural steel work. M.S. balusters, newels, M.S. flat frame work and posts as the case may be, shall be fabricated in a workman like manner.

57.5. FIXING/ERECTION : M.S. Balusters, newels, posts, M.S. flat frame work manufactured as per drawing and as per approved sample, shall be firmly fixed in the pockets left for fixing of balusters or weld to main steel of waist slab or landing slab or weld to the inserts left for fixing of balusters, posts etc. as shown in the drawing. Necessary cover plates at the base of the balusters shall be provided after grouting the balusters duly kept in position. The hand railing shall follow the inclination of stair in case of stair-case and shall be perfectly in line, level and plumb for all other railings. Any damage caused to treads/risers while fixing of balusters, posts, railings etc., the damaged tread and riser shall be removed and replaced by new ones at no extra cost. Railing shall be joined in lengths with plain butt joints, dowelled and held together by hand rails, bolts, clamps and M.S. frame work.

57.6. MODE OF MEASUREMENT : Hand railing shall be measured for payment in running meters. The length shall be measured along the top centre line of the hand rail and shall be measured between ends of balusters, newels posts as the case may be upto two places of a decimal. Rate to include fabrication, leaving suitable pockets, grouting the same, fixing, all labour, materials, transporting, painting, polishing, finishing, scaffolding if necessary and as described in the schedule of quantities.

* * *

58. RUBBER / P.V.C. WATER STOPS:

58.1. GENERAL: The corrugated Rubber/PVC water stops with centre bulb of specified width, shall be of approved manufacture and shall satisfy all the normal tests such as tensile strength, elongation etc.

58.2. SAMPLE : A sample of Rubber/PVC water stops shall be got approved from the Engineer-in-charge before procurement of bulk quantity.

58.3. PLACING IN POSITION : The water stops shall be provided in available maximum length and as far as possible, jointing shall be avoided. All the joints when unavoidable, shall be field jointed for water tightness as per manufacturers

specifications.

The water stops shall be positioned with suitable temporary supports so as to render adequate rigidity to the water stops while concreting. The exposed surfaces of water stops revealed after first concreting shall be cleaned thoroughly of all the droppings, mortar splashing, timber scantlings sticking etc. before the next pour of concrete is taken up in hand. Any damage caused to water stops shall be made good by the contractor at his own cost.

58.4. MODE OF MEASUREMENT : The mode of measurements shall be in running meter, of water stop actually laid without any allowance for laps, wastage etc., measured correct to one centimetre.

Rate shall include supply, transport, fixing, welding, supporting arrangements, cleaning etc. all as described above.

* * * *

59. DISMANTLING AND DEMOLITION :

59.1. SCOPE OF WORK :

The work envisaged under this sub-head is for dismantling and demolition of brick masonry in cement/lime mortar, reinforced cement concrete works, removing wooden chowkhats of doors, wooden or steel windows.

59.2. GENERAL :

The term Dismantling implies carefully taking up or down and removing without damage. This shall consist of dismantling one or more parts of the building as specified or shown on the drawings.

The term Demolition implies taking up or down or breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on drawings.

59.3. PRECAUTIONS :

Necessary propping, shoring and/or underpinning shall be provided for the safety of the adjoining work or property, which is to be left in tact, before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property.

Wherever required, temporary enclosures or partitions shall also be provided.

Necessary precautions shall be taken to keep the dust- nuisance down as and when necessary.

Dismantling shall be commenced in a systematic manner. All materials which are likely to be damaged by dropping from a height or demolishing roofs, masonry etc., shall be carefully dismantled first. The dismantled articles shall be passed by hand where necessary and lowered to the ground and not thrown. The materials then be properly stacked as directed by the Engineer-in-charge.

All materials obtained from dismantling or demolition shall be the property of the Government unless otherwise specified and shall be kept in safe custody until handed over to the Engineer-in-charge.

Any serviceable material, obtained during dismantling or demolition shall be separated out and stacked properly as indicated by the Engineer-in-charge within a lead of 150 m. or as specified in the item. All under serviceable materials, rubbish etc. shall be disposed off as directed by the Engineer-in-charge.

59.4. TREATMENT :

All the dismantled area shall be rendered clean off all debris, dust etc. The sides of jambs, sills, soffits etc. of the openings if any, after taking out doors and window chowkhats, unless and otherwise to be treated, shall be plastered in C.M. 1:3 with neeru finish to render true sides, corners, edges etc.

59.5. MODE OF MEASUREMENT :

59.5.1. Brick Masonry & R.C.C. Works : The measurement of brick masonry with or without plaster/painting shall be taken correct to a centimeter and volume calculated in cubic metres upto two places of decimal.

59.5.2. Doors and Windows : Dismantling of doors and windows (wooden or steel) shall be enumerated. Removal of chowkhats (frame works) shall include (unless otherwise separately mentioned for removing shutters only), the removal of shutters along with architraves, beadings, fittings and fastenings along with frames.

59.5.3. Roof Terracing : Dismantling of roof waterproofing treatment shall be measured in square metre area. .Length and breadth shall be measured correct to a centimeter between parapets. No separate measurement shall be taken for gola and khurrah etc.

59.6. RATES :

The rate shall include cost of all such operations mentioned above including necessary labour, materials, transport, scaffolding, stacking the serviceable materials, disposing the unserviceable materials within the lead specified, all as directed by the Engineer-in-charge.

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60. ROAD AND PAVEMENTS :

SCOPE OF WORK :

The work contemplated under these specifications refers to Earth work in Excavation, Forming Embankments, Soling, W.B.M., Bituminous Macadam, Wearing Course/Sealing Coat etc. for road and pavement works.

Concrete road shall be constructed as per IRC:15-2011 & IRC:44-2008, MORTH Specification & as per details shown in the drawing to the satisfaction of E.I.C

Approximate quantities of materials to be used in the work are listed below for reference:

SN	MATERIAL	DESCRIPTION	CONSUMPTION
i)	**Soling stone**	a) for 230 mm. thick consolidated thickness	2.65 cum./10 sqm
		b) for 150 mm. thick consolidated thickness	1.725 cum./1 0 sqm.
ii)	**Stone aggregate** 50 mm. nominal size	for 75 mm. thick consolidated W.B.M.	0.975 cum./1 0 sqm.
iii)	**Murrum**	for 75 mm. thick consolidated W.B.M	0.305 cum./10 sqm
iv)	**Bituminous macadam**	for premix carpets for 38 mm. consolidated thickness	11 sqm./mt.
v)	**Seal coat** (Bituminous concrete for wearing course)	for 12 mm. consolidated thickness	33 sqm./mt.

60.1. EARTH WORK IN EXCAVATION :

The specifications for "Earth work" under chapter - 1, specified here-in-before shall hold good as far as they are applicable.

60.2. FORMING EMBANKMENT :

The work shall include preliminaries of clearing site, setting out and preparing the ground and there after forming embankment for the roads, paths etc. with approved material available form excavations under this contract (excavation paid separately under respective items) or elsewhere, spreading in layers, watering and compacting to the required density and lines, curves, grades, camber and cross section and dimensions shown in the plan or as directed by the Engineer-in-Charge. When the embankment is to be laid on hill sides or slopes, the existing slopes are to be ploughed deeply. If the cross slopes are steeper than 1 in 3, steps with reverse slope shall be cut into the slopes to give proper hold and seating to the bank as directed by the Engineer-in-Charge. The top 15 cm. of soil shall be scarified and watered if directed and compacted to the same density as specified for the embankment before any material is laid for the embankment work.

Only the approved excavated earth shall be placed in the embankments in successive horizontal layers not exceeding 200 mm. extending to the full width of the embankment including the slopes at the level of the particular layer and 30 cm. more on both sides to allow compaction of the full specified section. The extra loose

stuff at the edges shall be trimmed later after completion of the bank work without extra cost leaving the correct section fully compacted.

Keeping the width of the bank initially less and widening it later by dumping loose earth on the slopes shall not be permitted as the additional width and slopes will remain loose and uncompacted. Similar procedure to extend the embankment by dumping the material longitudinally shall also not be allowed. Each layer of the embankment shall be watered, levelled and compacted as specified here-in-after, before the succeeding layers are placed. The surface of the embankment shall at all times during construction, be maintained in such a manner so as to prevent ponding. Water to be used shall be free from all harmful elements which may cause efflorescence etc. and approved by the Engineer-in-Charge.

If the material for embankment contains moisture less than the optimum moisture, water shall be added in the 100 mm. layers of the embankment to bring moisture uniformly upto requirement. If the excavated material contain more than required moisture, it shall be allowed to dry until the moisture is reduced to required extent. If due to the wetness, the moisture content of the soil cannot be reduced to the appropriate amount by exposure, embankment work shall be suspended till suitable conditions prevail at no extra claim/compensation.

When loose layer is levelled manually or mechanically and moistened or dried to a uniform moisture content suitable for maximum compaction, it shall be compacted by 8 to 10 tonne power roller or sheep foot rollers or heavy hauling or dozing equipment to give the specified 90% of the proctor density. If on testing, the density is found to be less than 90% of the proctor density, the contractor shall do additional compaction necessary to get the specified density after adding water if required. If the density cannot be improved by such reasonable efforts, the work may be accepted as substandard work by the Engineer-in-Charge, if he thinks it is not harmful for the purpose and paid for at a reduced rate. Test shall be made to determine the maximum density of the material to be used by the proctor method before starting the work. Density test shall be carried out for the embankment work during the progress of the work. One set of three core samples for every 1000 sqm. (about 1000 sq.yd.) area of each layer of embankment work shall be taken and tested. The average density shall not be less than 90% of the proctor density, obtained in the laboratory.

Arrangement for obtaining the samples and transporting the same to laboratory, shall be made by the contractor at his own cost.

Embankment not accessible to rollers, such as those adjoining bridges, culverts and other works shall be carried out independently of the main embankments and shall have the layers placed in 150 mm. to 200 mm. height and each layer shall be moistened and thoroughly compacted with mechanical or manual tamper. Before placing the next layer, the surface of the under layer shall be moistened and scarified so as to provide a satisfactory bond with the next layer.

The embankment shall be finished and dressed smooth and even, in conformity with the alignment levels and cross sections and dimensions shown on the drawing. On curves, section shall be provided with super elevation and increased width, as shown on the plans as directed by the Engineer-in-Charge.

Joining of old and new embankments shall be done by stepping in an overall slope of about 1 to 5.

The contractor shall be responsible for maintaining the embankment work in satisfactory conditions at his own cost till finally accepted including making good any damage.

MEASUREMENT AND RATE :

The contract rate shall be per cubic metre of the finished embankment. Measurements shall normally be taken by taking cross sections at suitable intervals. The measurements of the section shall be limited to the dimensions shown on the drawing or those ordered by the Engineer-in-Charge in writing. The sectional area shall be worked out correct upto two places of decimal of square metre and the quantity worked out to two places of decimal of cubic metre on lines similar to those specified for earth work here-in-before.

60.2ASUB GRADE :

Preparation of Sub-Grade : The surface of the formation for a width of sub-base, which shall be as per drawing shall first be cut to a depth equal to the combine depth of sub-base and surface courses below the proposed finished level (due allowance being made for consolidation). It shall then be cleaned of all foreign substances. Any ruts or soft yielding patches that appear due to improper drainage conditions, traffic hauling or from any other cause, shall be corrected and the sub-grade dressed off parallel to finished profile.

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

Surface Regularity : The finished surface shall be uniform and conform to the lines, grades and typical cross sections shown in the drawings. When tested with the template and straight edge, the variation shall be within the tolerances specified in the Table below :

PERMISSIBLE TOLERANCES OF SURFACE REGULARITY

Longitudinal profile	**Cross profile**
Maximum permissible undulation when measured with a 3 metre straight edge template.	Maximum permissible variation from specified profile when measured with a camber-
24mm	**15mm**

Where the surface irregularity of the sub-grade falls outside the specified tolerances, the contractor shall be liable to rectify these with fresh material or quarry spoils as the case may be, and the sub grade rerolled to the satisfaction of the Engineer-in-charge.

Measurement & Rate : The length and width shall be measured correct to a cm. The area shall be worked out in square metre, correct to two places of decimal. The rate shall include the cost of materials and labour required for all the operations mentioned above, unless specified otherwise.

60.3. SUB-BASES :

60.3.1. Water Bound Macadam Sub-base with stone aggregate : Stone aggregate of size 90 mm to 45 mm shall be used. This consists of clean crushed coarse aggregate mechanically interlocked by rolling using power road roller of 8 to 10 tonnes and voids thereof filled with screening and blinding material with the assistance of water, laid on a prepared sub-grade/sub-base.

SPECIFICATIONS FOR LAYING :

Quantities of Materials : Quantities of coarse aggregate, screening & blinding material required to be stacked for 100 mm appx. compacted thickness of WBM sub-base course for 10 Sqm. shall be as per table given below:

	Coarse		**Stone Screenings**		**Blinding material**
Classification	Size Range	Net Qty.	Grading/Classification and size	Net Qty	
Grading - I	90mm to 45mm	1.2 Cum. to	Type A 13.2 mm	0.27 Cum. to	0.08 Cum.

NOTE : Net Quantity = Loose Quantity measured in stack minus 7.5%

Preparation of Foundation : In the case of an existing unsurfaced road, where new materials is to be laid, the surface shall be scarified and reshaped to the required grade, camber and shape as necessary. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for W.B.M.

Spreading Aggregate : The coarse aggregate shall be spread uniformly and evenly upon the prepared base in required quantities with a twisting motion to avoid segregation. In no case shall these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed base be permitted. The aggregates shall be spread uniformly to proper profile by using templates placed across the road six metres apart. Where specified, approved mechanical devices may be used to spread the aggregates uniformly. The levels along the longitudinal direction upon which the metal shall be laid, shall be first obtained at site to the satisfaction of Engineer-incharge and these shall be adhered to.

The surface of the aggregate spread shall be carefully trued up and all high or low spots remedied by removing or adding aggregate as may be required.

The W.B.M. sub-base shall be normally constructed in layers of 115 mm compacted thickness. No segregation of large or fine particles shall be allowed and the coarse aggregate as spread shall be of uniform gradation with no pockets of fine material.

The coarse aggregate shall normally not be spread in lengths exceeding three days average work ahead of the rolling and blending of the proceeding section.

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

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

Rolling shall not be done when the sub-grade is soft or yielding or when the rolling causes a wave like motion in the sub-base or sub-grade. When rolling develops irregularities that exceed 12 mm when tested with a three metre straight edge, the irregular surface shall be loosened and then aggregate added to or removed from it as required and the area rolled until it gives a uniform surface conforming to the desired cross-section and grade. The surface shall also be checked transversely by template for camber and any irregularities corrected in the manner described above. In no case shall the use of screenings to make up depressions be permitted.

Application of Screenings : After the coarse aggregate has been lightly rolled to the required true surface, screenings shall be applied gradually over the surface to completely fill the interstices. Dry rolling shall be continued while the screenings are being spread so that the jarring effect of the roller causes them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles on the coarse aggregate but shall be spread uniformly in successive thin layers either by the spreading motion of the hand, shovels or a mechanical spreader.

The screenings shall be applied at a slow rate (in three or more applications) so as to ensure filling of all voids. Rolling and brooming shall continue with the spreading of the screenings. Either mechanical brooms or hand brooms or both may be used. In no case shall the screenings be applied, so fast and thick as to form cakes, ridges on the surface making the filling of voids difficult, or to

prevent the direct bearing of the roller on the coarse aggregates. The spreading, rolling and brooming of screenings shall be performed on sections which can be completed within one day's operation and shall continue until no more screenings can be forced into the voids of the coarse aggregate. Damp and wet screenings shall not be used under any circumstances.

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

Application of Blinding Material : After the application of screenings and rolling, a suitable blinding material shall be applied at a uniform and slow rate in two or more successive thin layers. After each application of blinding material, the surface shall be copiously sprinkled with water and the resulting slurry swept-in with hand brooms or mechanical brooms or both so as to fill the voids properly. The surface shall then be rolled by a 8-10 tonne roller, water being applied to the wheels in order to wash down the blinding material that may get stuck to the wheels. The spreading of blinding material, sprinkling of water, sweeping with brooms and rolling shall continue until the slurry that is formed well, after filling the voids form a wave ahead of wheels of the moving roller.

Setting and Drying : After final compaction of the course, the road shall be allowed to cure overnight. Next morning defective spots shall be filled with screenings or blinding material, lightly sprinkled with water, if necessary and rolled. No traffic shall be allowed till the macadam sets.

Surface Evenness : The surface evenness of completed W.B.M. sub-base in the longitudinal and transverse directions shall be as specified in the table given below:

Size of coarse aggregates	**Longitudinal profile**	**Cross profile**
	Max. permissible undulation when measured with a 3 M straight edge	Max. permissible undulation when measured with a camber template
45-90 mm	15 mm	12 mm

The longitudinal profile shall be checked with a 3 M long straight edge at the middle of each traffic lane along a line parallel to the centre line of the road. The transverse profile shall be checked with a series of three camber boards at intervals of 10 M.

Rectification of Defective Construction : Where the surface irregularity of the WBM sub-base course exceeds the tolerances specified in the table given above or where the course is otherwise defective due to sub-grade soil mixing with the aggregates, the layer to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable, and re-compacted. The area treated in the aforesaid manner shall not be less than 10 Sqm. In no case shall depressions be filled up with screenings and blinding material.

Measurements & Rate : The length and breadth shall be taken to the nearest centimetre and thickness to the nearest half centimetre. The consolidated cubical contents shall be calculated in cubic metres correct to two places of decimals. The rate shall include the cost of all labour and materials involved in all the operations described above.

60.3.2. RUBBLE SOLING :

Rubble soling for road work including foot paths, culverts, side drains etc. shall be carried out as specified here-inbefore under Chapter for Rubble stone soling, so far as they are applicable, with the following additions:

Subgrade for soling shall be prepared by cleaning of all foreign substances including rank vegetation, if any. Any ruts or soft yielding places that appear due to improper drainage conditions, traffic, hauling or from any other cause, shall be corrected by filling/cutting upto 150 mm. and compacted and the subgrade dressed off parallel to the finished profile and the same shall be approved by the Engineer-in-Charge, before laying of soling. Soling shall be laid in regular lines and staggered joints. The stones shall be laid as closely as possible and packed well. The stones shall be so laid as to have their bases and the largest area resting on the subgrade and in contact with each other.

Soling shall be laid to proper gradient and camber which shall be checked frequently to ensure accuracy. Rolling shall then be carried out by a 8 to 10 tonne power roller and soling consolidated properly shall be lightly sprinkled during rolling, if ordered by the Engineer-in-Charge.

The surface thus prepared shall first be passed by the Engineer-in-Charge, after which 40 mm. to 50 mm. thick layer of selected hard murrum available from excavation shall be spread over the soling as directed by the Engineerin-Charge, and rolled again such that the hard murrum gets into the interstices. It shall, however, be ensured that a thin layer of murrum/grit shall remain on the finished surface of soling.

The area of soling actually done of specified consolidated thickness limiting to the dimensions as per drawing, shall be measured in square metre upto two decimal places.

60.4. WATER BOUND MACADAM :

a) **Metal :** Metal required for water bound macadam surfacing shall be broken from the first sort rubble. The rubble shall be broken to required size by the contractor at his own cost. However, the metal required for water bound macadam shall conform to I.R.C. specification in all respects. It shall be hard, sound, trap stone metal free from decay and weathering and obtained from approved quarries, and shall be of 50 mm. nominal size.

b) **Collection of metal :** Metal shall be of first sort black trap stone and shall be collected in stacks on level ground and stacked on the sides of the road as directed. The metal shall be free from all earth, rubbish and vegetable matter and graded before stacking and closely packed in stacks. The metal supplied by the contractor shall be arranged in stacks for measurement. No deductions will be made for voids. The size of stack shall be 1 m. wide at top, 2.2 m. wide at bottom and 60 cm. high. The length shall be as directed by the Engineer-in-Charge. The contractor shall provide the templates required to ensure, compliance with size of stack stipulated.

c) **Supply of Murrum :** The contractor shall be permitted to excavate in the selected areas in the township/site of work, as approved by the Engineer-in-Charge, for collection of murrum. The excavation shall be done by the contractor to correct line and level, transport and stack the same at site of work as directed by the Engineer-in-Charge. Alternately, the contractor will be permitted to bring from outside, approved graded hard murrum 10 mm. down to dust (but not silt) as directed by the Engineer-in-Charge and shall also be collected in stacks on level ground along side of the road.

The stacks shall be measured in cubic metre for payment before using it for blinding. No deduction shall be made for voids.

d) Laying and preparation of water bound macadam surface :

i) After preparation of the existing surface as specified above, 50 mm size metal collected in stacks shall be spread to uniform thickness over the prepared surface and consolidated to 75 mm thickness as specified here-in-after.

ii) Templates properly made of full width and gauge or templates fitted with central plumb to each edge fixed with it must be used. The depth of the plank forming the gauge shall be the thickness of the metal layer in loose state so that when the metal has been properly spread, the gauges are buried just flush with the surface. The intermediate work shall be tested with cord stretched between the gauge. Three templates shall be provided and used with a distance of about 7.5 Metres between each but not exceeding 15 Metres. A spirit level shall invariably be used with the templates to ensure that the edges of metalling are truly levelled. The metal shall be spread and rolled with 8 to 10 tonne power roller until well compacted and there is no appreciable movement (in the metal) when walked upon, or no appreciable wave in front of the advancing roller. Rolling shall be done by roller perfectly, by a 8 to 10 tonne power roller, till proper internal packing of adjacent pieces of stones has

been achieved. Excessive dry rolling shall be avoided.

iii) Rolling shall commence from the edge to the centre of the road. In case of super elevated curve, rolling shall commence from the inside edge of the centre and progress towards the outside edge. Where the gradient is steeper than 1 in 60, the roller shall run up grade, i.e. rolling shall be started from lower level to upward direction for the 1St. rolling.

iv) While rolling the surface in two or more parts, a strip of about 230 mm. to 300 mm. along the predetermined cross section shall be left unrolled while consolidating the first half. This shall be properly jointed when the metal is being spread on the second half and consolidated with it. Care must be taken to avoid the occurrence of a continuous longitudinal furrow along cross section of the road. Full width of road will be rolled at a time.

v) The metalling shall be moderately kept saturated and rolling continued until consolidation is completed. Just enough watering shall be done so as to flush the metal slurry into the interstices. Care shall be taken to avoid excess water softening the subsoil. The full consolidation stage shall be tested by (a) putting a piece of metal about the size of wal-nut on the surface and roller passed over it. If it is crushed the surface shall be deemed as well consolidated (b) there shall be no creeping of stone ahead of the roller.

vi) Until the above conditions are satisfied, no blinding or surfacing materials shall be put on the surface. No rolling shall be done where signs of metal crushing are noticed or rolling causes wave like motions in the base course of sub-grade. Over rolling shall not be done. About 20 to 30 trips of the roller shall normally suffice to make the surface well compacted. Before starting rolling, the metal shall be dressed accurately to camber. No fresh metal shall be added once dry consolidation has commenced. The part of the road must be fully raked up so that the metal is thoroughly incorporated into the body of road.

i. **Blinding Course :** When the required consolidation has been completed, the blinding material of approved graded murrum/stone grit and dust (unscreened) as specified shall be spread over the surface and brushed backwards and forwards to fill in the surface voids and rolling and watering continued to such an extent that the blinding materials are formed into a slurry and is grouted into the interstices. After the road has been fully consolidated, the surface shall be covered with 12 mm layer of murrum/stone grit and dust (unscreened) and road opened to traffic after 4 days. The road shall be kept watered for 14 days or such other period as specified by the Engineer-in-charge. Where tracks are likely to be formed by the traffic on the road, barriers such as tree branches etc. shall be put to divert the traffic. After 15 days, light watering and rolling shall be done. For joints across the road, the end of each layer shall be given a flat slope and well consolidated together and hump formation must be avoided.

ii. **Damages to the Owners's Property :** Any damage to the **Owners's** property due to negligence of the contractor while executing the work shall be made good to the original condition by the contractor at his own cost.

iii. **MODE OF MEASUREMENT :**

The areas of water bound macadam road surfaces of required thickness actually completed as per above specifications limiting to the areas as per drawing shall be measured in square metre upto two places of decimal,for payment.

The item includes laying, spreading, watering, consolidation, blinding etc. but excluding the cost of 50 mm size I.R.C. metal and graded murrum which will be paid under relevant item. However Murrum obtained from excavation work under this contract and used as blinding material as above on instructions/approval of the Engineer-in-charge shall not be paid.

60.5. BITUMINOUS MACADAM & BITUMINOUS CONCRETE SURFACING FOR ROAD (GENERAL) :

SCOPE OF WORK :

The work covered under these specifications provides for bituminous treatment for roads consisting of providing 38 mm thick bituminous macadam and 12 mm thick seal coat or bituminous concrete of thickness as specified in item in the schedule of quantities.

The contractor shall make at his own cost, all the arrangements for controlling the traffic during the execution of the work. All arrangements such as proper barricading of road, diversion of road if necessary, red and green flags during the day, red lights at nights shall be made by the contractor at his own cost to control and safeguard the traffic.

60.5.0. BITUMINOUS MACADAM OVER WATER BOUND MACADAM :

60.5.1. Preparation of Existing Water Bound Macadam Surface : The existing water bound macadam surface shall be brushed, cleaned properly with wire brushes and coir brooms, so as to free from all loose materials, murrum, earth, silt and caked mud etc. The surface shall then be dusted clean with gunny bags etc. If during the process of cleaning the sub grade (water abound macadam), soft spots and pockets, hollows etc. are found, such spots/pockets will be filled with approved precoated bituminous chips, consolidated and finished to proper level, rolled with power roller if necessary. The pot holes shall be excavated properly in a rectangular or rhomboidal shape with vertical edges. The bottom and sides shall be cleaned as stated above. The sides and bottom shall then be thoroughly painted with heated 60/70 penetration bitumen. The pot holes shall thereafter be filled with premixed bituminous chips so that after thorough tamping and rolling, the surface is flush with surrounding road surface all as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to ensure that the subgrade is even and is finished to camber and slope as shown on the drawings or as directed by the Engineer-in-Charge.

The surface of the subgrade shall be checked for its trueness by means of the scratch template resting on side forms having scratch points placed at not less

than 200 mm. apart and set to the exact profile of the base course. The template shall be drawn along the forms at right angles to the road.

Unevenness of the surfaces as indicated by the scratch points shall not exceed 10 mm. in 30 m. The area of depression shall then be painted or sprayed with 60/70 penetration bitumen at the rate of 0.75 kg. per sqm. and the leveling course applied by hand or machine to grade and camber and rolled. If the depressions are deeper than 50 mm., the levelling course shall be applied in two or more layers and rolled as directed by the Engineer-in-Charge.

The prepared surface shall be closed to traffic and maintained fully clean and no asphalting work shall be started unless this prepared surface is approved by the Engineer-in-Charge.

60.5.2. MATERIALS :

Representative samples of materials proposed to be used shall be submitted to the Engineer-in-Charge and got approved. No material shall be used unless it is approved by the Engineer-in-Charge.

60.5.3. HOT MIXED HOT LAID BITUMINOUS MACADAM :

1. **Coarse Aggregate :** It shall consist of crushed hard trap stone metal, free from coatings of clay, silt and any objectionable material. Metal brought by contractor for different items of work shall strictly conform to I.R.C. specifications in all respects. The aggregate shall be obtained by crushing approved stones of specified type in mechanical crusher and shall be hard, close grained, sound trap stone metal, free from decay and weathering and obtained from approved quarries.

   Metal shall be collected in stacks on level ground and neatly stacked at site of mixing. The metal shall be free from all earth, rubbish, vegetation and other foreign matter and graded before stacking and closely packed in stacks.

   Tests considered necessary shall be carried out in an approved laboratory when the Engineer-in-Charge considers the quality to be doubtful or there is a dispute about the quality. The cost of testing shall be borne by the contractor.

   AGGREGATE GRADING : The requirements of base course shall be as under:

B.S. Sieve Designation	Equivalent I.S. Sieves	Passing percentage
32 mm. (about 1.25")	40 mm. (1.5")	100
20 mm. (about 3/4")	20 mm.	50 - 100
12 mm. (about 1/2")	12.5 mm.	30 - 60
6 mm. (about 1/4")	6.3 mm.	18 - 30
No. 10	1.7 mm.	10 - 20
No. 200	75 micron	0 - 5

The aggregate/chips shall be entirely dry at the time of mixing.

2. **Bitumen :** Bitumen to be used shall conform to I.S. 73-1992 for paving bitumen, with 60/70 penetration and shall be from approved manufacturers.

   The contractor on demand by the Engineer, obtain and furnish a laboratory test certificate to the effect that the material conforming to the requirement of the specified grade, to the satisfaction of the Engineer-in-Charge. Bitumen (60/70 penetration) content 3.7% to 4.7% by weight of the total mix, shall be used in the mixture.

3. **Tack Coat :** Bitumen of the same grade as that used for premix shall be heated to a temperature of 163^{0}C to 177^{0}C (325^{0}F to 350^{0}F) in a bitumen boiler and the hot bitumen shall be applied evenly to the thoroughly cleaned and prepared road surface (as specified here-in-before) @ 7.5 kg. per 10 sqm. leaving no part of the surface unpainted. Application shall be done by a mechanical pressure sprayer or if permitted, by perforated pouring cans. The tack coat shall be applied just before the macadam is laid. Application of tack coat shall be only slightly in advance of laying premixed chips.

   In case of surface already asphalted, application of tack coat is not necessary.

4. **Premixing Chips :** The bitumen shall be heated to 163^0 C to 177^0 C (325^0 F to 350^0 F) in boiler. The aggregate of the approved grading or as decided by the preliminary tests shall be dried and heated in an aggregate drier to a temperature of 149^0 C to 177^0 C (300^0 F to 350^0 F) and fed into a twin shaft peddle type mixer at a temperature not less than 149^{0}C (about 300^{0}F). The bitumen, the approved aggregate and the filler shall be measured separately and accurately to the proportions in which they are to be mixed and mixed intimately till all the particles are completely coated with bitumen. Asphalt/bituminous mixing plant proposed to be used by the contractor for the preparation of Asphalt/bituminous mixing shall conform to all of the requirements of the job, which shall produce uniform mixtures of the required quality, and got approved by the E.I.C before mixing.

   The temperature of the premix bituminous macadam when leaving the mixer shall not be less than 130 0 C (about 280^0 F) and it shall not be less than 121^0 C (about 250^0 F) at the time of laying.

   Bituminous macadam shall be transported to site of work in suitable tipping vehicle properly insulated and covered with canvas or other suitable materials to protect the mixture from weather conditions and to retain the heat. The road surface shall be suitably marked to ensure correct and uniform application. Width of macadam to be laid shall be slightly more (not exceeding 50 mm. on each side) than the required carriage way as per drawing. Excess on either side shall be neatly cut after full compaction to get final width of carriage way as per drawing. The premixed bituminous macadam shall be laid by a mechanical self powered spreader and compactor and finished to correct line, level, & final consolidation done by means of power roller not less than 10 tonne. Any irregularities shall be corrected during rolling.

5. **Compaction :** The base bituminous macadam course shall be compacted thoroughly and evenly with 10 to 12 tonne power roller immediately after it is laid. Compacted thickness shall be as specified in schedule of quantity.

   The surface shall be checked for correct grade during and after rolling. Any irregularities shall be corrected by adding precoated chips or removing the surplus. The disturbed surface shall be well compacted again. If necessary, the roller wheel shall be coated with oil to prevent the coated chip from sticking to the wheels. Rolling shall be continued till no wheel marks are left on the surface. The speed of the roller shall be sufficiently slow to prevent any pushing under the wheels.

60.6. HOT MIXED HOT LAID BITUMINOUS CONCRETE WEARING COURSE (SEAL COAT) :

1. **Bituminous concrete :** shall consist of mixture of mineral aggregate, sand and filler, graded to fill the voids, mixed with bitumen binder to obtain the maximum stability and durability. It shall be spread and compacted on a prepared bituminous macadam base in conformity with lines, grades and cross section shown in the drawings. The aggregate shall be preheated the temperature specified for the bitumen and the mixture shall be prepared and laid hot.

2. **Coarse Aggregate :** The coarse aggregate brought by contractor shall be I.R.C. hard black trap, crushed in mechanical crushers and shall be clean, strong, tough, dense, close grained, angular but not flaky, and free from soft, decayed, weathered portion, coating of dust, dirt or other objectionable matter. Maximum size of the aggregate shall be suitable for the thickness of the seal coat (12mm./15mm. or as specified).

   The aggregate grading composition and characteristics of surface (wearing course mix) shall conform to standard code of practice. The mix shall satisfy the following requirements:

Bitumen :	7.25 (+/-) 0.25% by weight of
Voids of air in total mix :	2% by weight of mix and 4% by
Specific gravity	Not less than 2.3.
Marshall stability :	453.6 kg (1000 lb.) minimum
Flow :	1020.
Water absorption :	0.50%

3. **Fine Aggregate :** The fine aggregate shall be clean, natural, river bank or pit sand or quarry sand produced in a crushing plant and satisfying the requirement of the grading of aggregate for the bituminous concrete as stated above or as determined by the preliminary tests.

   Filler : The filler shall be dry and clean lime stone powder hydrated lime having calcium oxide content of not less than 60% both passing B.S. sieve No.8. It shall be free from lumps and loosely bonded aggregation. When tested by laboratory sieves, 100% shall pass through B.S. sieve No.14, 80% shall pass through B.S. sieve No.8. Fillers shall be added to the aggregate to give the above grading determined by preliminary tests.

4. **Bitumen :** Bitumen shall be of 60/70 penetration or such other grade specified by the Engineer-in-Charge and shall conform to I.S. 73-1 961.

   The tenderers shall indicate the exact grading, bitumen content, voids, specific gravity etc. which they propose to adopt for type to treatment offered by them.

5. **Preparation of Base :** Dirt,dust and other foreign materials if accumulated shall be cleared off leaving the surface entirely clean. The prepared surface shall be closed to traffic and so maintained fully clean till the seal coat is applied.

6. **Mixing and Laying Wearing Course :** Grade 60/70 bitumen shall be heated to a temperature of 163^0 C to 177^0 C (325^0 F to 350^0 F) in a boiler. The aggregate of the suitable approved grading or as decided by preliminary tests, shall be dried and heated in an aggregate drier to a temperature of 149^0 C to 177^0 C (300^0 F to 350^0 F) and fed into a twin shaft peddle type mixer at a temperature not less than 149^0 C (300^0 F). The bitumen, the aggregate and the filler shall be measured separately and accurately to the proportions in which they are to be mixed and mixed intimately till all the particles are completely coated with bitumen. The quantities of aggregate, bitumen and the filler shall be such as to obtain the percentage of each as specified above or decided after tests. Continues batching and mixing plant shall be used. Asphalt/bituminous mixing plant proposed to be used by the contractor for the preparation of asphalt/bituminous mixes shall conform to all of the requirements of the job, which shall produce uniform mixtures of the required quality.

   The temperature of bituminous concrete when leaving the mixer shall not be less than 138^0 C (280^0 F) and it shall not be less than 121^0 C (250^0 F) at the time of laying.

   The bituminous concrete shall be transported to the site of work in suitable tipping vehicles properly insulated and covered with canvas or other suitable materials to protect the mixture from weather conditions and to retain the heat.

   The mixture shall be spread with mechanical self powered spreader. The bituminous concrete shall be laid to the specified line, curve, grade and camber. Any irregularities shall be corrected immediately before rolling is started. Before laying the mixture, the faces of the joints shall be painted with a uniform coating of hot bitumen. The bituminous concrete shall be laid to such loose depth as to give a compacted layer of specified thickness as per item in the schedule of quantities.

7. **Compaction :** The bituminous concrete layers shall then be allowed to cool sufficiently such that it does not spread under wheel load of 10/12 tonne power roller. The compaction shall be done by the roller till no wheel mark are left on the surface and no further compaction is possible. The road shall be opened to traffic on cooling of the concrete to the atmospheric temperature or after a lapse of 24 to 40 hr. after laying.

GENERAL REQUIREMENTS FOR BITUMEN MACADAM & SEAL COAT:

1. **Testing :** The contractor shall have a well equipped testing laboratory with a competent laboratory staff. Daily tests (not less than two specimen per day)

shall be made by them on the bituminous mixture produced to ensure compliance with these specification and copy of the test results duly signed by the competent authority shall be submitted to Engineer-in-Charge for record. Tests shall include water absorption, stability, filler content etc.

The contractor shall give all facilities at all times to the Engineer-in-Charge or his representative to inspect the work or testing done by him.

2. **Weighing :** Each lorry leaving the plant must be weighed on a weigh bridge in the presence of the representative of the E.I.C and a challan must be issued along with the lorry in duplicate showing the weight of the material loaded in the lorry. As and when required, the said lorries shall also be weighed at weigh bridge approved by the Engineer-in-Charge to check the tonnage of the material stated on the challans. In case of short fall, the same shall be made good by the contractor without extra cost.

3. **Testing Surface :** The completed surface when ready for acceptance shall be thoroughly compacted, smooth, true to line, grade, camber and free from irregularities when tested by means of a straight edge of 3 m. long, laid on the finished surface parallel with the centre line of the road, the surface shall in no place vary more than 6mm. from the working edge.

4. **MODE OF MEASUREMENT :**

i) Measurement for bituminous macadam including filling in pot holes and depressions shall be paid by weight measured in metric tonne used on the job, completed satisfactorily, measured upto second place of decimal including preparing surface, applying tack coat and compacting by roller etc. complete as specified.

ii) Measurement for bituminous concrete (seal coat) shall also be paid by weight as measured at site of work, irrespective of the thickness laid, in Metric tonne used on the job, compacted satisfactorily, measured upto second place of decimal including all the relevant items of work specified.

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61. FENCING WORK WITH BARBED WIRE, CHAIN LINK ETC. :

The work shall generally be carried out as per these specifications, relevant drawings and as directed by the Engineer-in-Charge.

61.1. M.S. POSTS AND STRUTS :

All the M.S. posts/struts shall be free from rust, scale, cracks, twists and other defects and shall be fabricated to the required shape and size out of the specified sections. The posts and struts shall be conforming to relevant specifications stipulated here-in-before under relevant sections. All the posts and struts shall be of sizes and lengths as specified in the tender schedule and drawing. The posts and struts shall have split ends for proper fixing and shall be embedded in the cement concrete of mix. 1:3:6 or as specified in the schedule. The exposed surfaces of the posts and

struts shall be painted with two coats of synthetic enamel paint of approved make and shade over a coat of approved primer.

61.2. R.C.C. POSTS AND STRUTS :

All the posts and struts shall be of standard size as specified in schedule. These shall be casted on suitable places/platforms in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm. nominal size) as per relevant specifications stipulated here-in-before. The reinforcement shall be provided as shown in the drawings, as directed by Engineer-in-Charge and specified here-in-before under relevant sections. The posts and struts shall be free from honeycombing, cracks and other defects.

After casting, the posts/struts shall be left at the same place and cured for a minimum period of 7 days. After 7 days curing the same shall be shifted to a levelled ground and stacked for further curing for 14 days. After 21 days of curing only, the posts/struts shall be transported to work site without any damage, for fixing in position.

61.3. SPACING OF THE POSTS AND STRUTS :

The spacing of posts shall be 3 m. centre to centre unless otherwise specified or as directed by the Engineer-in Charge, to suit the dimensions of the area to be fenced. Every 10th posts, last but one end posts, corner posts, and posts where the level of fencing changes in steps and end post when the fencing changes its direction shall be strutted on both sides, or as directed by the Engineer-in-Charge. End posts where barbed wire fencing is discontinued shall be strutted on one side only.

61.4. FIXING OF M.S./R.C.C. POSTS AND STRUTS :

Pits of size 45 x 45 x 45 cm. deep or of sizes mentioned in the drawings, shall first be excavated centrally in the direction of proposed fencing work, true to line and level to receive the posts. In case of struts, the pits shall be so excavated, as to receive minimum 15 cm. concrete cover at any point of the struts to suit its inclination or as shown in the drawing.

The pits shall be filled with a layer of 15 cm. thick cement concrete of specified mix. The posts and struts shall then be placed in the pits, the posts projecting to the specified height above ground level, true to line, plumb and position, by providing adequate supports temporarily, and cement concrete of specified mix. shall then be filled-in so that the posts are embedded in cement concrete blocks of specified sizes. The concrete in foundation shall be watered for atleast 7 days to ensure proper curing.

61.5. BARBED WIRE :

The barbed wire shall be of M.S. or G.I. as specified and it shall generally conform to I.S. 278-1978.

The base metal of the line and point wire shall be of good commercial quality mild steel. The line and point wire shall be circular in section, free from scales and other defects and shall be uniformly galvanised if specified.

The line wire shall be in continuous lengths and shall generally be free from signs of welds. It shall be able to withstand Wrapping and unwrapping 8 turns round its diameter.

The barbed wire shall consist of two splices per reel. The barbed wire shall be formed by twisting two lines wires one containing the barbs.

The barbed wire and its weight shall be as given in the table below:

Type	Nominal diameter of wire				Nominal distance between two barbs in mm	Mass of complete barbedwire (in gm./m.)	
	line wire (in mm.)		point wire (in mm.)				
1.	2.50	(12 G)	2.50	(12 G)	75	146	(136-155)
2.	2.50		2.50		150	114	(108-120)
3.	2.50		2.00	(14G)	75	117	(108-125)
4.	2.50		2.00		150	96	(89-1 03)
5.	2.24	(13 G)	2.00		75	102	(97-1 06)
6.	2.24		2.00		150	82	(78- 85)

The barbs shall carry four points and shall be formed by twisting two point wires, each two turns, tightly round one line wire, making altogether 4 (four) complete turns. The barbs shall be so finished that the four points are set and locked at right angles to each other.

The barbs shall have a length of not less than 13 mm. and not more than 18 mm. The points shall be sharp and well pointed. Barbed spacings shall be as given in the above table. Wherever required for every 50 reels or part thereof, samples of the barbed wire and the individual line wires shall be put to tensile test and in case of failure to conform to tensile properties given below, two additional tests of each kind shall be made on the samples cut from other reels.

TENSILE PROPERTIES :

Size of line wire	Breaking load of line wire	Min. breaking load of

Nominal dia (in mm)	Min. (in Kg.)	Max. (in Kg.)	complete barbed wire (in Kg.)
2.50 (12G)	216	302	444
2.24 (13G)	128	179	263

On the results of these additional tests, the whole or portion of the barbed wire shall be accepted or discarded as the case may be.

61.5.1. Fixing of Barbed Wire : The barbed wire shall be stretched and fixed in number of rows and two diagonals as specified. The bottom row shall be 140 mm. above ground and the rest at 125 mm or at given spacing as per drawing. The diagonals shall be stretched between adjacent posts from top wire of one post to the bottom wire of the 2nd post. The diagonal wires will be interwoven with horizontal wires by fixing the odd rows of wires, then the diagonal cross wires and lastly the even rows of wires. The jointing of the barbed wire in between the posts shall not be permitted.

Necessary holes should be tapped in the post and the barbed wire shall be fixed in position by means of 'U' clamps or bolts and nuts as specified in drawings. In case of fixing with 'U' clamps, the legs of the 'U' clamps passing through the 10 mm. dia. hole in the R.C.C. post to hold barbed wire shall be turned up and down to get an over-lap of 25 mm. on the face of RCC post. Turn buckles and straining bolts shall be used at the end posts if specified.

61.5.2. MODE OF MEASUREMENT :

The work shall be measured in running metre length of fencing correct to a centimetre for the finished work, from centre to centre of the posts.

The rate shall include the cost of labour and materials involved in all the operations described above including the cost of barbed wire, turn buckle, straining bolts, bolts and the nuts/U clamps including excavation and foundation concrete or as specified in item description for the work.

61.6. CHAIN LINK :

The chain link shall be of approved manufacture and of correct size, gauge etc. It shall be of M.S. or G.I. as specified of approved manufacture and of required size, gauge etc. The base materials of the wire shall be of good commercial quality mild steel. The wire shall be circular in section, free from rust, scale, cuts, welds and other defects and shall be uniformly galvanised if specified.

61.6.1. FIXING OF THE CHAIN LINK FENCING TO M.S. OR R.C.C. POST :

The chain link of specified height of fencing shall be fixed first to the end post with necessary G.I. approved type U clamps threaded at both the ends and G.I. nut, bolts, washers etc. and with 6 mm. dia. full height M.S./G.I. anchor bar. After fixing the chain link at the end post, it shall be stretched tightly and fixed to next post one after the other by the above mentioned clamps and bars

etc. leaving 50 mm. clearance from the ground and 20 mm. clearance in the case of concrete coping at bottom to avoid rusting. The point at the change in level of the fencing top/bottom, necessary links shall be adjusted suitably as per the manufacturers specification or as directed by the Engineer-in-Charge. The entire chain link fence shall be painted with two coats of synthetic enamel paint of approved make and shade over a coat of approved primer or as specified in the item/drawing.

61.6.2. MEASUREMENT :

The work shall be measured in running metre length of fencing correct to a centimetre for the finished work from centre to centre of the posts.

The rate shall include the cost of labour and material involved in all the operation described above including the cost of barbed wire, turn buckle, straining bolts and bolts and the nuts/U clamps, 6 mm. dia. M.S./G.I. anchor bar etc. including excavation and foundation concrete or as specified in item description for the work.

* * * *

62. M. S. CRIMPNET GATE :

62.1. MATERIALS :

All steel work, pipe frame work and crimpnet shall be of sizes and sections as per drawings. They shall generally conform to relevant I.S. specifications. The G.I. crimpnet shall be unless otherwise stated, 25 x 25 mm. x 8 g. and of approved manufacture.

62.2. INSTALLATION :

For each leaf of the gate, the crimpnet shall be fixed tightly to internal angle iron frame of required size by means of suitable welding. This internal angle iron frame is then fixed to outer frame of 50 mm. dia. seamless pipes by means of 65 mm. long angle iron lugs welded together. Suitable cleats for the locking arrangement are welded at the height as shown in drawing. Both the leaves of the gates thus be fixed over suitable hinges provided on the side M.S. channel posts of specified sizes. The side post which shall be erected prior to fixing the gates shall be welded with m.s. plates 250 x 150 x 5 mm. at bottom. These posts shall be properly embedded in cement concrete foundations of specified sizes and allowed to set properly.

All the assembly mentioned above shall be properly erected correct to line, level, plumb and render easy and proper movement of shutters.

62.3. The shutters, channel posts and all other steel parts shall be thoroughly cleaned and painted with red oxide primer of approved make and shade. Final painting with two coats of flat oil/synthetic enamel paints of approved shade and make shall be done as directed by the Engineer-in-Charge and as per specifications.

62.4. MODE OF MEASUREMENT :

The length of the gate shall be measured clear in between the side m.s. channel posts and height between the extreme ends of pipes, correct to half centimeter and area worked out in sqm. correct to two places of decimals.

The rate shall include the cost of all materials mentioned above viz. crimpnets, m.s. angles, G.I.pipes, guide plates, channels, base plates, hinges, locking arrangement and other accessories as also necessary excavation in pits, embedding cement concrete, painting etc. all complete. The rates shall be valid for areas in variance by about (+/-) 10% in the overall size of the gate.

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63. DRAINAGE WORK WITH NP2 CLASS RCC HUME PIPES :

63.1. R.C.C. SPUN PIPES :

The pipes shall be R.C.C. spun pipes NP2 class, conforming to I.S. 458-1971 and shall be approved by the Engineer-in-Charge for soundness before incorporation in the work.

63.2. LAYING R.C.C. SPUN PIPES :

The work consist of providing, laying, jointing and testing R.C.C. spun pipe storm water drain of required diameter as mentioned in the schedule to discharge storm water to the main nallah as shown in the drawing.

After the cement concrete cradle has been laid properly, if specified or as directed by the Engineer-in-Charge, the pipes shall be lowered gradually into the trenches over the concrete cradle or bed. Necessary working space/gap for collars shall be made at every joint. Laying of pipe shall proceed upgrade of a slope. The collars shall be slipped-on before the next pipe is laid.

The pipe drain shall rest on the bed at every point through its length. To ensure this the space between the underside of the pipe on the invert of the cradle shall be carefully grouted solid with cement slurry consisting of one part of cement to one part of clean washed sand in such a manner that no void is left. It shall be ensured that the load of the pipes and the super imposed load of the earth filling is evenly distributed on the cradle or bed.

The contractor shall take precautions to see that no dirt, earth or other foreign matter is allowed on the surface of the cradle or bed of the pipe resting there-on, all to the full satisfaction of the Engineer-in-Charge. After the alignment and grading of the pipes is checked by the authorised representative of the E.I.C, the grouting shall be done with specified stiff mix of cement mortar.

The cradle of concrete shall be allowed to set at least for three days before any pipe is placed on it and the contractor shall take due care in setting the pipe in the cradle so that no damage is occur to the cradle. If any damage to the cradle occurs, it shall be rectified to the satisfaction of Engineer-in-Charge and in any particular

case where damage to the cradle is beyond repair in the opinion of the Engineer-in-Charge, the contractor shall cut out the damaged section of the cradle and re do the same at his own expenses to the complete satisfaction of the Engineer-in-Charge.

No pipe shall be laid or placed till the alignment of the pipe drain and its levels and gradient have been carefully checked and found correct/approved by the Engineer-in-Charge.

63.3. JOINTS :

The joints for the pipes shall be made by loose collars and the connecting space shall be as minimum as possible. The collars shall be specifically roughened inside to provide a better grip.

The two adjacent pipes will be so designed and manufactured that when butted together concentrically, a dowel is left between the two ends. In this dowel, cement mortar of (1:1) proportion or mix. as specified in the schedule be filled and then between the ends a paste of cement mortar of the same proportions will be placed. The space remaining between the pipe ends and the collar being then caulked with cement mortar of (1:1) or other specified proportion so that an even space appears all round the external diameter of the pipes. All the joints shall be finished off smooth at an angle of 45o with the longitudinal axis of the pipe on either side of the collars.

The interior of the pipe drains shall be cleaned off all dirt, cement mortar and superfluous materials and joints shall be cured for atleast 7 days.

63.4. TESTING OF R.C.C. SPUN PIPES :

After sufficient interval has been allowed for the joints to set, the pipe drains will be tested under a water head of at least 1.2 m. and in no case under a head greater than 1.8 m. of water above the top of the pipes. In addition, the pipe drains shall be examined for leaks of land/sub-soil water making its way through the joints. The contractor shall make the pipe drains water tight against the entrance of land/sub-soil water from outside and also against the leakages of water from the inside of the pipe drains at the test heads specified above to the full satisfaction of the Engineer-in-Charge.

All defective or leaking pipes or joints shall be cut out and replaced and made good by the contractor at his own cost. In case of the joints that may be defective and cannot be made good, shall be entirely embedded/surrounded externally with cement concrete of 1:2:4 proportion to render the joint (s) water tight and this shall be allowed to set before encasing or back filling is done. A strong colour shall be added to the water used for testing of the pipes, in order to detect any leakage easily. The cost of testing of the pipe drain shall be borne by the contractor and is deemed to be included in the rates quoted by the contractor.

63.5. ENGINEER-IN-CHARGE MAY ORDER CONCRETE TO BE INCREASED OR DIMINISHED :

The Engineer-in-Charge may increase or decrease the concrete on the pipe drains as to the quantity and quality or to omit the same entirely according to the nature of

the ground that may be revealed when the storm water drain trenches are excavated.

63.6. Back filling/filling Trenches :

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm. watered, rammed and consolidated, taking care that no damage is caused to the pipe below. In case of excavation of trenches in rock, the filling upto a depth of 30 cm. above the crown of pipe or barrel shall be done with fine material such as earth, murrum or pulverised decomposed rock according to the availability at site. The remaining filling shall be done with rock filling or boulders of size not exceeding 15 cm. mixed with fine material as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30 cm.

63.7. MODE OF MEASUREMENT :

The length of pipes shall be measured in running metre nearest to a centimetre along the centre line of the pipes over all fittings such as collars, bends, junctions etc. Fittings/specials shall not be measured separately.

The rate shall include the cost of materials and labour including jointing, grouting, cutting of pipes to the required lengths, wastages etc. involved in all the operations described above.

Excavation, back filling, shoring and timbering in trenches and cement concreting wherever required shall be measured separately under relevant items of work.

* * *

64. ROUGH / NATURAL FACED SHAHABAD STONE PAVEMENT:

64.1. MATERIALS :

Hand cut rough/natural faced shahabad stone shall be of the best quality and of the specified thickness, size etc. and shall be got approved by the Engineer-in-Charge. The sizes given in schedule of quantities are tentative and can vary only slightly as per the availability in the market. At its thinnest, no stone shall be thinner than specified thickness. The stone shall be hard, sound, durable, tough, free from flaws, cracks, decay & weathering. The edges shall be hand cut and dressed true and squares. The evenness of surfaces and edges of the slabs shall not be marred by careless dressing or handling and no patching up shall be allowed for the slab. The edges shall be reasonably straight. The under face may be left as required or rough dressed. Before taking up the work, samples of stone slabs to be used and their dressing shall be got approved by the Engineer-in-Charge. The work shall be carried out strictly in accordance with the approved samples.

64.2. BEDDING/BACKING COAT :

In case of plinth protection or other pavements over concrete sub base, the mortar bedding shall be of cement mortar of thickness and mix specified in the item of tender schedule.

In case of pavement work for footpaths, approaches and other similar works, to be laid directly over levelled and consolidated ground, the bedding shall be of 150 mm. thick quarry spoil and 60 mm. thick stone grit or as specified/directed by the Engineer-in-Charge.

64.3. LAYING AND FIXING THE STONE SLABS/ TILES :

The specifications for Kotah stone flooring/skirting/facia described here-in-before shall hold good as far as it is applicable except that the joints shall be pointed with C.M. 1:3 or with other specified mix, finished flush/with grooves as specified/directed. The joints shall be raked out uniformly to a depth of not less than 12 mm. before grouting and pointing the same.

64.4. CURING :

The pavement work shall be kept well wetted for atleast seven days.

64.5. CLEANING :

When the bedding and joints have completed, set and attained required strength, the surface shall be thoroughly cleaned and handed over free from any mortar stains, dust, dirt etc.

64.6. MODE OF MEASUREMENT :

The above pavement work shall be measured in square metre correct to two places of decimal. The length and breadth shall be measured net correct to a centimetre. The pavement under skirting/dado/wall plaster, if any, shall not be measured for payment.

No deduction shall be made nor extra paid for any opening of area up to 0.10 sqm. Nothing extra shall be paid for use of cut tiles/slabs nor for laying the pavement at different levels.

NOTE : Wastage in obtaining the required sizes as specified from the commercial sizes available in market is deemed to be taken in to consideration by the contractor while quoting the rate. The work shall be measured as above and no extra claim on this account will be entertained.

65. UNDERDECK INSULATION SYSTEM

The Under deck thermal insulation shall be done with NEOPOR Board which offers greater insulating performance with low water absorption and up to 50 percent lower use of materials and 20 percent better insulating performance than conventional EPS, helping environmental conservation and saving money. Environmentally-friendly Neopor insulating materials do not contain CFCs, HCFCs, HFCs or other halogenated cell gases.

They contain air as the cell gas, which guarantees the preservation of the thermal conductivity throughout the life of the construction.

Technical Properties

Parameters	Property	Code Compliance
Colour	Silver – gray	
Dimension, Thickness	1000mm*500mm, 120mm	
Fixing Arrangement	Adhesive	
Compressive Strength @ 10% deformation	100-150 kpa	DIN EN 826
Fire Behaviour	B1	DIN 4102
Long term water absorption (28 days)	≤ 3	DIN 12087
Tensile Strength	≥ 200	DIN 1607
Thermal Conductivity @ 10 deg C mean temperature	< 0.031 W/mK	DIN 52612
Ozone depleting substance	Free of HFC,CFC,HCFC	EU Council Regulation 1005/2009
Thermal Resistance Value	21 sft.OF.hr/Btu	

The product should be manufactured by a company certified to conform to the requirements of the quality, environmental and occupational health & safety standards ISO 9001, ISO 14001 and OHSAS 18001.

Method Statement for Under Deck Insulation Using Neopor Boards

A. Underdeck Thermal Insulation Layer

The thermal insulation built-up would be done in a highly technical manner using the latest technologies, products and innovations. The product shall be NEOPOR of BASF of 50mm thick. The insulation boards of Neopor to be fastened to the roof slab from below using tile adhesive Mastertile 30 The high performance tile fixing adhesive shall be cementitious polymer modified powder. The adhesive shall be free from chlorides.

B. Method Statement for Underdeck Insulation

1) Surface preparation - The substrate shall be free from laitance, curing compound, oils and any foreign substance which would inhibit the bonding of the Neopor board to the substrate. The substrate shall be smooth; any undulations greater than 3 mm shall either be grinded or finished with Emaco 303. The substrate shall be lightly abraded mechanically with buffing wheel/ angle grinder/hacking. The substrate shall be saturated with water prior to application of Neopor board

2) **Markings**- Any identification points or markings left on the slab shall be transferred to the wall or the floor, which after completion of insulation shall be remarked on the insulation board. The deck slab shall be marked and divided in such a way that the edges receive at least 300 mm wide Neopor board.

3) **Application**- The surface of Neopor board which will receive Master tile 30 shall be sanded/ abraded. Mastertile 30 shall be applied on the Neopor board using 6mm notch trowel. First take a small quantity of Mastertile 30 and apply it with force pressing it against the board with a flat trowel. Take further quantity and use a 6 -8 mm notch trowel. Mastertile 30 shall be removed from the periphery of the board at least 25 mm wide. The consumption is approx. 4 - 5 kg/Sqmt.

4) **Placing-**The Neopor boards shall be placed along the marking and pressed upward using both the hands for 10 to 15 seconds and tapped lightly. Care should be taken while placing the board so that each Neopor board fits in the tong and groove arrangement. Drilling for fixing of the anchors shall be done immediately while the person is still holding the Neopor board. The depth of hole shall at least be 25 mm in the concrete. After drilling anchors shall be fixed in the drill hole at 1 anchor per board.

5) The initial markings which were transferred on the walls and the floor shall be transferred back on to the Neopor Boards.

C. Installation Of Underdeck Neopor Boards At The Site Conditions

1. Removal of Shuttering Marks - The projections of shuttering marks should be chipped and grinded. Form release agents should be removed and surface prepared as per the given method statement.

2. Suspenders for False ceiling - The suspenders for false ceiling shall be installed after the installation of Neopor Boards

3. Suspenders for Fire Hydrant - The suspenders for fire hydrant / firefighting conduits to be installed after the installation if Neopor Boards.

4. HVAC Duct - The HVAC ducts to be installed after the installation of Neopor board.

5. Pipes fixed to the Wall - The pipes fixed to the wall should be in a straight line. Groove to be cut in the Neopor board with the help of Hot knife or sharp knife and fixed on the slab.

Since 2, 3 and 4 are fixed with the help of suspenders the installation of Neopor Boards to be done first and then the suspenders shall be installed.

66. SIESMIC ARCHITECTURAL EXPANSION JOINT SYSTEM

The SIL or equivalent Seismic Architectural Expansion Joint System (SRFL) is capable to accommodate multi – directional seismic movement without stress to its components.

SIL or equivalent Aluminum Roof Cover are engineered for flat or sloped roofs with expansion joints subjected to thermal & seismic movement. They handle ice, snow loads & occasional maintenance foot traffic while providing maximum resistance to UV rays & moisture deterioration.

The SRFL or equivalent System's Seismic self – centering devices allow the slide plate to return to its natural position after a seismic occurrence.

General Properties of SIL Seismic Architectural Expansion Joint System (SRFL):-

SRFL or equivalent system provides heavy-duty seismic control system capable of accommodating multi – directional seismic movement without stress to its components.

Throughout the service, the system shall resist the passage of water through the joint opening, by utilizing Moisture Barrier Membrane provided underneath the joint assembly.

The joint system provide water tight roof joint location, aluminum base member designed to accommodate various project conditions & roof treatment.

The system resists damage or deterioration from impact of falling ice, exposure to UV, airborne contamination & occasional foot traffic from maintenance personal.

Components:-

1) Aluminum Extrusion: - Aluminum Extrusion is having groove to accommodate head of self-centering bar, for providing movement and rotation.

2) Aluminum Cover Plate: - Cover plate of suitable thickness is secured to joint assembly utilizing a heavy duty self – centering bar that freely rotates in all directions.

Cover plate shall have beveled edges to provide safety to the pedestrian traffic.

3) Aluminum Flange Extension: - Aluminum Flange Extension of suitable thickness is field attached to base member by using machine screw 450 mm center to center.

4) Self Centering Bar: - Self centering bar is provided with circular sphered ends thatlock and slide inside the corresponding aluminum extrusion cavity to allow

freedom ofmovement and flexure in all directions including vertical displacement. Sphered ends shallbe corrosion resistant molded nylon (or equivalent). Spacing shall be a maximum of 450mm center to center. Threaded anchor assembly hardware is used for attachment of coverplate to self – centering bar.

5) Moisture Barrier Membrane: - Water proof Moisture Barrier membrane is provided underneath the aluminum extrusion in the blockout portion in width that safely allows for maximum movement and flexibility to the joint system.

6) Anchorages: - Anchor bolts of 6 mm dia. (min). having self expansion capacity inconcrete are spaced at maximum 300 mm center to center.

Design Features:-

1) Maintenance free system capable of accommodating multi – directional seismic movement.

2) Metal Plates available in Aluminum or Stainless Steel options.

3) Moisture Barrier Membrane for complete water tightness.

4) Design suitable for Exterior sloped roofs or flat roofs condition.

5) Regain its original position after Seismic movement occurrence.

6) The Joint system is suitable for movement capacity up to 914 mm in Slop condition roofs or flat roofs.

Fabrication:-

1) Aluminum Extrusion and generic profiles are supplied in standard 10 Ft. lengths and are cut to length on job site as required. All profiles are miter cut in the field to conform to directional changes unless otherwise contracted with expansion joint manufacturer.

2) Moisture Barrier Membrane are supplied in the longest practical continuous length in standard packing.

Material Specification:-

1) Aluminum Cover Plate: - Conforming to ASTM 6063, or Equivalent Indian or Foreign Grade (Cover plate in Stainless Steel are also available in option).

2) Aluminum Flange Extension: - Conforming to ASTM 6063, or Equivalent Indian or Foreign Grade.

3) Aluminum Extrusion: - Conforming to ASTM 6063, or Equivalent Indian or Foreign Grade.

Finishes:-

1) All other Aluminum Extrusion and shapes are supplied in standard mill finish.

Installation:-

1) All expansion joint components parts shall be protected from damage during installation, placement of roof materials and thereafter until completion of structure.

2) Expansion joint system shall be installed in strict accordance with the manufacturer's typical details and instructions along with advice of their representative.

3) Expansion joint system shall be set to the proper width for the ambient temperature at the time of installation.

Cleaning & Protection:-

System and its components shall be protected during construction. After work completion, exposed surface is cleaned with a suitable cleaner that will not harm or attack the finish.

The SIL Seismic Architectural Expansion Joint System is for wider joints exposed to Heavy Loading or when design considerations call for the ability to accommodate multi – directional seismic movements.

SAPX or equivalent Model employs heavy-duty Aluminum Base members with Excellent load carrying capability.

Slide plates are available with Aluminum as well as Stainless Steel options.

The SAPX or equivalent System's Seismic Self – centering devices allow the slide plate to return to its natural position after a seismic occurrence.

General Properties of SIL Seismic Architectural Expansion Joint System (SAPX):-

SAPX or equivalent system provides heavy-duty seismic control system capable of accommodating vehicular loads and multi – directional seismic movement without stress to its components.

Throughout the service, the system shall resist the passage of water through the joint opening, by utilizing Moisture Barrier Membrane provided underneath the joint assembly.

The traffic-bearing surface of the system shall consists of a flat cover plate with beveled edges designed of a width and thickness to satisfy projects movement and loading requirements.

Components:-

1) Aluminum Extrusion: - Aluminum Extrusion is having groove to accommodate head of self-centering bar, for providing movement and rotation.

2) Aluminum Cover Plate: - Cover plate of suitable thk. is secured to joint assembly utilizing a heavy duty self – centering bar that freely rotates in all directions. Cover plate shall have beveled edges to provide safety to the pedestrian traffic.

3) Aluminum Flange Extension: - Aluminum Flange Extension of suitable thk. is field attached to base member utilizing countersunk flathead machine screw spaced at 300 mm center to center (maximum).

4) Self Centering Bar: - Self centering bar is provided with circular sphered ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Sphered ends shall be corrosion resistant molded nylon (or equivalent). Spacing shall be a maximum of 450 mm center to center. Threaded anchor leaf spring assembly hardware is used for attachment of cover plate to self – centering bar.

5) Moisture Barrier Membrane: - Water proof Moisture Barrier membrane is provided underneath the aluminum extrusion in the blockout portion in width that safely allows for maximum movement and flexibility to the joint system.

6) Anchorages: - Anchor bolts of 8 mm dia. (min). having self expansion capacity in concrete are spaced at maximum 450 mm center to center.

Design Features:-

1) Maintenance free system capable of accommodating multi – directional seismic movement.

2) Metal Plates available in Aluminum or Stainless Steel options.

3) Moisture Barrier Membrane for complete water tightness.

4) Available with SIL Concrete as an edge void filler.

5) Design suitable for Parking Structures with wider joints Exposed to heavy loadings.

6) Regain its original position after Seismic movement occurrence.

7) The Joint system is suitable for movement capacity up to 657 mm in Parking Decks, Platform, Top Slab, Loading Docks & other structures.

Fabrication:-

1) Aluminum Extrusion and generic profiles are supplied in standard 10 Ft. lengths and are cut to length on job site as required. All profiles are miter cut in the field to conform to directional changes unless otherwise contracted with expansion joint manufacturer.

2) Moisture Barrier Membrane are supplied in the longest practical continuous length in standard packing.

Material Specification:-

1) **Aluminum Cover Plate**: - Conforming to ASTM 6063, or Equivalent Indian or Foreign Grade (Cover plate in Stainless Steel are also available in option).

2) **Aluminum Flange Extension**: - Conforming to ASTM 6063, or Equivalent Indian or Foreign Grade.

3) **Aluminum Extrusion**: - Conforming to ASTM 6063, or Equivalent Indian or Foreign Grade.

Finishes:-

1) Cover plate's exposed surfaces are provided with Serrations for skid resistance.

2) All other Aluminum Extrusion and shapes are supplied in standard mill finish.

Installation:-

1) All expansion joint components parts shall be protected from damage during installation, placing of concrete and thereafter until completion of structure.

2) Expansion joint system shall be installed in strict accordance with the manufacturer's typical details and instructions along with advice of their representative.

3) Expansion joint system shall be set to the proper width for the ambient temperature at the time of installation.

Cleaning & Protection:-

System and its components shall be protected during construction. After work completion, exposed surface is cleaned with a suitable cleaner that will not harm or attack the finish.

General Properties of SIL Seismic Architectural Expansion Joint System (SCTR):-

The material shall be such that it provides wall and ceiling expansion control system that accommodates multidirectional movement and having a variety of metal and color finishes available to compliment adjacent finish surface treatments. Metal profiles may be preformed or extruded and utilize a continuous structural inter-lock fastening strip for ease of component assembly. The system shall be capable of following changes in direction to achieve a "corridor wrap" concept in high visible areas.

Components and Materials

A. Exposed Upper Component and Slide Plate - Standard and Optional Materials shall be:

1. Aluminum (standard) conforms to properties of ASTM 6063 "guaranteed anodized quality". Thickness shall be .080".

2. Brass (optional) conforms to properties of CDA260, 70% COPPER, WITH #4 satin texture. Thickness shall be .080".

3. Stainless Steel (Optional) conforms to properties of ASTM 304. Thickness shall be 14 ga. (.075").

Preform upper edge components indicated on manufacturer's standard drawing. Beveled or inclined inside edges adjacent to slide plate will be a design requirement.

A.2 Extruded Upper Component - Material shall be extruded aluminum confirming to properties of ASTM 6063.

B. Lower Edge Component – Material shall be 18 ga. Galvanized steel conforming to manufacturer's specifications.

C. Slide Gasket - Material shall be a pre-cut medium density foam with adhesive on one side and a light weight, nylon fabric laminated to the other side.

Color: black. Size shall be ¼ inch in thickness by 3/8 inch wide. For Models CTR, CTC 200-600 utilize manufacturers standard polyvinylchloride extruded profile.

D. Slide Plate Limit Clips – Material shall be a U-Clip fastener preformed from spring steel. Maximum spacing shall be as recommended by manufacturer.

E. Fastening System – Fastening system shall be inter - lock fastening strips backed with pressure sensitive acrylic adhesive. Minimum width shall be 1 inch and length shall run continuous along expansion control system edge component. Minimum dynamic tensile disengagement strength shall be 16 lbs/in2.

F. Anchors – Anchors shall be min. 10 mm diameter. x 1-1/2 inch long Phillips drive panhead self-drilling TEK screw. Maximum spacing shall be 18" o.c.

G. Accessories - Necessary and related parts required for complete installation.

H. Fire Barrier Assembly – Joint shall be capable to withstand indicated or required dynamic structural movement without material degradation or fatigue. Tested in maximum joint width conditions with a field splice as a component of expansion joint

cover in accordance with manufacturer's specifications at a full rated period by a nationally recognised testing inspecting organization. Joint system shall be provided with suitable Flame Guard or Thermo Shield Fire Barrier as governed by joint opening and fire rating.

Fabrication

A. Metal components with slide gasket and fastening system shall be shipped in 10 ft. lengths and shall be cut to length on job site where required. Components shall be miter cut in the field to conform to directional changes unless otherwise contracted with expansion joint manufacturer.

B. Anchor Holes at lower edge component shall be field drilled in accordance with contract drawings.

C. Fire Barriers - Ship manufacturer's standard assembly including fire caulks, Sealants (if applicable) and hardware for the required hourly rating. Assemblies shall be miter cut in the field to accommodate changes in

direction.

Finishes

A. Exposed Upper Edge Component And Slide Plate

I. Aluminum

Standard – Clear anodized finish.

Optional

a) Color Choice with matte finish

b) Color Choice with bright finish

EXECUTION

Installation

A. Protect all expansion joint component parts from damage during installation and placement of wall or ceiling materials and thereafter until completion of structure.

B. Expansion joint systems shall be installed in strict accordance with the manufacturer's typical details and instructions along with the advice of their qualified representative.

C. Expansion joint systems shall be set to the proper width for the ambient temperature at the time of installation. This information is indicated in the contract plans.

Clean and Inspect

Upon completing install the contractor shall clean all exposed metal surfaces with a suitable cleaner that will not harm or attack the finish. Contact manufacturer should questions arise regarding suitability of any cleaner type prior to its use.

66. AUTOCLAVED CELLULAR (AREATED) CONCRETE BLOCK MASONRY

66.1. Scope of Work : The work covered under this specifications pertains to procurement of best quality locally available or locally manufactured precast AAC concrete solid block and workmanship in building walls of various thickness in strict compliance with the specifications and applicable drawings.

66.2. Material: Precast cement concrete solid blocks shall be of best quality locally available/ manufactured at factory and should be approved by the Engineer-in-Charge before incorporation in the work. The ingredient and the cement concrete used shall confirm to relevant I.S. as stipulated in specification for cement concrete works herein before. **Autoclaved aerated cement blocks of approved quality of Grade 1 as per IS 2185 Part III.**

Minimum crushing strength of the AAC blocks shall be 5 N/ sqmm. at 28th day after curing and dry density shall be not less than 651-750 kg/cum. The type of the bond to be adopted will be decided by the Engineer-in-Charge but vertical joints shall be staggered. The thickness of the blocks shall be 100 mm, 150 mm & 200 mm and the proportion used in making the blocks shall be as per IS code. The blocks shall be cured well at least for 14 days before incorporation in to the work. The cement mortar for concrete blocks masonry shall be 1:4 and joints shall not be more than 10 mm. thick.

66.3. Workmanship and Mode of Measurement: The workmanship and mode of measurement shall be as stipulated in the specification for brick work as applicable stated earlier and AAC block masonry with 140 mm. thick block shall be measured in sqm. nearest to two places of decimals of a meter. The rate quoted shall include cost of all materials, labour including form work in casting the blocks, curing, transporting, handling, hoisting the blocks to proper level, curing masonry etc. complete.

66.4. Mode of measurement: All AAC blocks masonry walls shall be measured in Sqm. All opening in AAC block work for doors, windows and ventilators shall be deducted to get the net quantity of actual work done. Opening or chases required for P.H. or electrical inserts less than 0.1 sqm. And bearing of precast concrete members shall not be deducted. No extra payment shall be made for extra work involved in making the above opening or placement.

67. READYMIX CEMENT PLASTER (READIPLAST)

67.1 General: Readiplast is a factory made pre blended sand-cement plaster with polymers supplied in dry form. It is made of Cement (OPC), Graded processed silt free and clay free River sand, polymers and fibers. These ingredients of known quality and are blended exactly in correct ratio. It is ready to use cement based mortar for external as well as internal plaster which ensures waterproof crack free plasters of consistent quality. It is a mixer of graded inert filler, additives blinder and fiber generally meet to IS code 2250 -1981.

67.2 Mixing: Take precise quantity of water and pour into mechanically mixer or can be loaded into plastering machine and slowly add the Rediplast mortar into mixer at 0.15 W/P ratio and mix it thoroughly for application.

67.3Application: Clean the substate take out loose particles. Wet the surface , except those of cement concrete blocks thoroughly and apply Readiplast to achieve uniform thickness and level surface. Mixed Rediplast mortar after adding water should be used within 60 minutes.

67.4Curing: Water curing is recommended after 12 hrs. and to be continued for at least 7 days.

67.5Mode of measurement: Mode of measurement will as per schedule of quantities

APPENDIX "A"

LIST OF APPROVED MAKE / MODEL

PREAMBLE:

1) All materials shall conform to relevant technical specifications of Volume – 4 of the Tender document. The materials shall be further subjected to tests in the recognized laboratories at the sole discretion of the Engineer-in-Charge and shall be at contractor's cost.

2) The contractor shall procure TMT bars of **Fe415/Fe415D/Fe500/Fe550/Fe550D** grade (the grade to be procured is to be specified) from primary steel producers such as **SAIL, Tata Steel Ltd., RINL, Jindal Steel & Power Ltd. ; Essar steel and JSW Steel Ltd .**

3) Reinforcement for work shall have relevant IS marking and every lot shall be subject to tests in the recognized laboratories and shall be at contractor's cost.

A. Civil, Interior Finish Work

Following are the list of preferred makes to be used in execution of works, unless otherwise specified in Bill of Quantities.

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
1.	Cement 53 Grade / 43 Grade	Gujarat Ambuja (Silicate), ACC (Suraksha), Ultra-tech, Birla Plus (Grasim), Vasavadatta (Birla Shakti)
2.	White Cement	Birla cement, JK cement, Orient
3.	Ready Mix Concrete	Ultra tech, Hella, Indiacrete , Procon
4.	AAC blocks	Ultratech, Ascolite, Siporex, Godrej & Boycee
5.	Synthetic plaster	Renovo, Ruff & Tuff, Spectrum, Oikos
6.	Putty	Birla White Putty, JK, Dr FIXIT, Asian
7.	Steel (Thermo Mechanically Treated Steel) High strength deformed bars or mild steel reinforcement (TOR-Steel)	TATA, SAIL, JSW ,RINL, Jindal, Ispat, Vizag
8.	Structural Steel sections/members/Chequered plate	TATA, SAIL, JSW ,RINL, Jindal, Ispat, Vizag
9.	Clay Bricks	Good quality locally available material approved by Engineer / Architect
10.	Vitrified/ Ceramic/Glazed Tiles/ Anti skid/Acid and alkali resistant tiles	Nitco, Kajaria, RAK, Bells, Johnson /Regency/Bells. Euro, Asian Granito, AGL
11.	Stainless Steel	Jindal/SAIL
12.	Aluminium sections	Jindal , HINDALCO, NALCO, BALCO
13.	Aluminium Composite Panels (ACP)	Alutech india, E3 panels, Aludecor, Alstone, Alex, Altobond
14.	DGU Glass	Saint gobain/Asahi
15.	Glass	Modi, Saint Gobain, Hindustan Palington, Asahi, Triveni
16.	Wood preservatives	Woodguard, PCI, Black Japan, Asian paint, Pidilite
17.	Sun control film or Frosted film	Garware, LG, 3M
18.	Stainless steel sink	Nirali , Diamond, Jindal
19.	Rubber flooring	Sandick, NORA, Responsive
20.	Modular doors & partitions	Greenlam, Merino
21.	Flush doors	Century/Anchor or equivalent
22.	Melamine polish	Asian paint, ICI, NEROLAC
23.	Panelled Doors	National, Century, Swastik, Kitply
24.	P.V.C. Doors	Sintex, Supreme, Eurostar, Ozone

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
25.	Fibre Reinforced Plastic (FRP) Door	Astral, Durian, Everest
26.	Gyp. board	India gypsum, National gypsum, Gypsonite
27.	Vertical blinds	Vista, Mac, Universal
28.	Rockwool	Rockwool/Twiga
29.	Blinds	Hunter Douglas, Mac, Vista, Technifab, Ferrari
30.	Roller Blinds fabric	Vista, Mac, Universal
31.	Wallpaper	Arte, Marshall ,Ego ,softek, Elemento
32.	Plywoods (commercial and Marine)	Anchor , Archid , Century , Kenwood , Garnet , Samrat , Greenlam, Prince, Mayur (6mm, 9mm, 12mm, 19mm or any other thickness.
33.	Laminates (Interior works)	Formica , Greenlam , Century , Signature, Heritage , Archid , Bravia Newmica, Kitmica
34.	Laminates (Exterior works)	Greenlam , Stylam, Merinon EWC, Fundermax
35.	Block board	Anchor, Century, Archid, Green, Marino, Multiply
36.	Soft Board (pin up board)	Jolly board, Western India plywood.
37.	Pre-Laminated Particle boards	SRB boards, Bison, Elite, Action TESA, Century. Krifor (12mm, 19mm or any other thickness.
38.	Veneer	Anchor , URO, Century, Greenlam
39.	Adhesives	Fevicol (SH), Mowicoll, Mahacol, Araldite , Astral, Super bond
40.	Screws	GKW, Mettle fold
41.	Brass hinges	Magnum, Reliance, Punit heavy duty, Ace Hardware.
42.	Hardware	DORMA, Hafele, Hettich, Blum, Shalimar, Ozone, Everite, Reliance, Ace Hardware, Kich
a)	**Stainless Steel powder** coated hinges	**Palladium, Haffle, Kich, DORMA, Hettich**
b)	Mortise lock - Brass or Stainless steel mortise lock of 6 lever	Hafele , DORMA, Hettich, Kich, Godrej, Ultra, Atomberg, QUBO, Kich
c)	Tower bolts - Stainless steel and brass	Hafele , DORMA, Hettich,Kich
d)	Door closers	Hafele , DORMA, Hettich,Kich, Efficient gazets, Everite Hyper.
e)	Floor spring	Hafele , DORMA,Hettich
f)	Drawer shutter lock	Godrej /Vijayan - (3 set of keys).
g)	Ball catch	Magnetic (M-2) / Brass.
h)	Door lock / handles	4-C ACME, Golden, Godrej, Ultra, Atomberg, QUBO, Kich
43.	Wood preservatives	Woodguard, PCI, Black Japan, Asian paint, Pidilite
44.	Sun control film or Frosted film	Garware, LG, 3M
45.	Stainless steel sink	Nirali , Diamond, Jindal
46.	Paint (luster, emulsion)	Burger, Nerolac, Asian, Dulux, Tractor.

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
47.	PU paint	Nerolac. ICI, Asian, MYK arment
48.	Epoxy paint	Epoxy, Dulux, Berger, MYK arment
49.	Texture Paint	Vista, Asian, Oikos, Acro , Surfa
50.	Water proofing material / solution/compound.	Fosroc, Dr, Fixit, Sika. Roff , Sunanda, Krishna Conchem, Asian, Mapei, MYK arment
51.	Red Oxide	Asian, Berger, Nerolac
52.	Polymer, PMM. & Polymer Modified Crack filler	Fosroc, Dr, Fixit, Sika. Roff , Sunanda, Krishna Conchem, Asian, Mapei, acro- chem, MYK arment
53.	Composite marble	Kalinga stone, AGL Classic Marbles, Johnson
54.	Calcium Silicate board / tile	Ramco Hilux, wedge india, Galaxy Refractories
55.	High density cement fibre board/ Cement board	Everest, Visaka
56.	Acrylic Exterior paint	Asian Ultra/Nitcotex / Sandtex / Berger Weathershield
57.	Iron monjires and brass fittings	Enox, Archis, doorset, ozone, dorma,
58.	C P plumbing Fittings / Toilet Accessories	Jaquar, Hindustan, Plumber, Asian Essess, parry ware, Bells, Cera
59.	Vitreous sanitary ware (ISI mark)	Jaquar, Hindustan, Plumber, Asian Essess, parry ware, Bells, Cera
60.	Seats & Covers solid (W.C.)	Jaquar, Hindustan, Plumber, Asian Essess, parry ware, Bells, Cera
61.	PVC Low level flushing cisterns	Jaquar , Parry ware, Hindustan, Cera
62.	Concealed Cistern with flush plate	Jaquar, Hindustan, Plumber, Asian Essess, parry ware
63.	Sanitary Fixture	Jaquar, Hindustan, Plumber, Asian Essess, parry ware
64.	Ball & wheel valves	Zoloto, LEADER, AUDCO
65.	UPVC Pipes (S/W/R Pipes)	Supreme, Finolex, Prince
66.	G.I. Pipes & fittings	Tata, Zenith, JINDAL, SWASTIK
67.	S.W. Pipes / Fittings & Gully traps	Perfect, Trimurti
68.	C.I. Manhole Cover	RIF, BIC, Neco
69.	R.C.C. Pipes	Indian Hume pipe
70.	PVC Fittings (Moulded)	Supreme, Finolex, Prince
71.	Non-return valve	Intervalve
72.	Stoneware Pipe and fittings	Trimurti, Perfect Potters, Bharat
73.	Stoneware Pipe and fittings	Trimurti. Perfect Potters, Bharat
74.	For Structural Repair works	Fosroc, Sunanda, BSF, Krishna conchem or Dr Fixit, MYK arment or Equivalent as approved by MDL
75.	FRP Manhole cover with frame	Everlast, Fibrocast
76.	NP 2 Class Hume Pipe	Locally available (Vishwa/Bharat/Indian pipes/Arihant)
77.	CPVC pipes	Astral, Supreme, Finolex , Prince
78.	Anchor fastener	Hilti, Fisher
79.	Polyethylene tank	Sintex, Prince, Astral
80.	Furniture	Godrej, Burosys, Space wood, Danco, Monarch, Durion

S.N.	DESCRIPTION OF MATERIAL	MAKE OF MATERIALS
81.	Galvalume/GI roof/cladding she	PHENIX Infra, Kingspan, LLOYD Insulations (I) Ltd, JSW, Jindal, tata
82.	Polycarbonate sheets	GE, Lexan, Danpalon, polygala
83.	uPVC roofing sheet and associated accessories such as ridge, Flashings, Approns, L- corner, Facia Drop and gutter with joiner ,drop outlet , end cap,drain end cap	Viraat, Dion, Roof Touc, Sun-arch, Arihant roog

Note (i) Wherever make is specified in BOQ, the same shall prevail over list of preferred make.
(ii) Wherever specification of BOQ item is not mentioned ; then CPWD specification shall be applicable.
(iii) Wherever make is specified in BOQ then manufacture's specifications & procedure shall be applicable.
(iv) Wherever no specifications or make is specified than work is to be carried out as per the written instruction of the Engineer-In-Charge

APPENDIX "B"

THEORETICAL STANDARD REQUIREMENT OF CEMENT FOR VARIOUS ITEMS OF WORK

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
1	Cement Concrete 1:5:10	Cum	2.60
2	Cement Concrete 1:4:8	Cum	3.40
3	Cement Concrete 1:3:6	Cum.	4.40*
4	Cement Concrete 1:2:4	Cum	6.40*
5	Reinforced Cement Concrete 1:2:4	Cum	6.40*
6	Reinforced Cement Concrete 1:1.5:3	Cum.	8.00*
7	Reinforced Cement Concrete 1:1:2	Cum	12.20*
* **Note :** For controlled concrete items like M-10, M-15, M-20, M-25 etc., the consumption of cement will have to			
be assessed by the Engr-in-Charge on the basis of design mixes approved for			
8	Brick masonry in C.M. 1:4	Cum.	1.90
9	Brick masonry in C.M. 1:6	Cum	1.25
10	Half brick masonry in C.M. 1:4 with RCC 1:2:4 stiffeners	Sqm.	0.27
11	Half brick masonry in C.M. 1:4	Sqm	0.21
12.(a)	R.R. Masonry in C.M. 1:6	Cum.	1.65
12.(b)	C.R. Masonry in C.M. 1:6	Cum.	1.56
13.	**IPS Flooring (C.C. 1:2:4, finished smooth)**		
(a)	30mm. thick	Sqm	0.23
(b)	40mm. thick (smooth/broom finish)	Sqm	0.30
(c)	50mm. thick	Sqm	0.36
(+)	20mm. thick skirting/dado in cm.1 :3	Sqm	0.30
14	Hardonate flooring -50mm. thick (C.C. 1:2:4, finished smooth)	Sqm.	0.41
15	**Kota stone:**		
(a)	Flooring (with lime mortar bedding pointed with matching cement slurry)	Sqm	0.13

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
(b)	Skirting with 20mm. thick C.M. 1:3 backing	Sqm	0.27
(c)	Coping	Sqm.	0.13
16	**Terrazzo tile :**		
(a)	Flooring (with lime mortar bedding & pointed with cement slurry).	Sqm	0.18
(b)	Skirting with 20mm. thick C.M. 1:3	Sqm	0.28
(c)	Treads, hydraulically pressed with C.M. 1:3 bedding	Sqm.	0.37
(d)	Treads in one piece	Sqm	0.28
(e)	Risers, hydraulically pressed with C.M. 1:3 backing	Sqm.	0.28
(f)	Risers in one piece	Sqm	0.23
17.	**Cast-in-situ terrazzo**		
(a)	Flooring, 40mm. th. (28mm C.C. 1:2:4 + 12mm with marble chips & powder)	Sqm	0.26
(b)	Skirting, 20mm. thick (12mm CM1:3+ 8mm marble chips with cement & marble powder)	Sqm	0.25
18.	White glazed tile flooring and dado over 20mm. C.M.1 :3 bedding	Sqm	0.31
19.	**Cement tile :**		
(a)	flooring (lime mortar bedding).	Sqm	0.18
(b)	skirting with 20mm thick C.M. 1:3	Sqm	0.28
20	Plaster skirting, 20mm. thick in C.M.1 :3.	Sqm	0.30
21.	Cuddapah stone kitchen platform over 20mm. thick C.M. 1:4	Sqm	0.30
22	Cuddapah stone window sill over 20mm. thick C.M. 1:4	Sqm	0.27
23	Fixing hold fasts in CC 1:3:6 of size 300x100x150 mm. for doors & windows	100 Nos	2.20
24.	Cement Plaster in C.M. 1:4/1:5 with neeru finish		
(A)	**Cement Mortar 1:4**		
(a)	12 mm. thick	Sqm	0.11

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
(b)	15 mm. thick	Sqm	0.13
(c)	20 mm. thick.	Sqm	0.17
(B)	**Cement Mortar 1:5**		
(a)	12 mm. thick	Sqm	0.09
(b)	15 mm. thick	Sqm	0.11
(c)	20 mm. thick	Sqm	0.14
25.	**Cement plaster in C.M. 1:4 in two coats with neat cement punning**		
a)	15 mm. thick.10mm + 5mm (for ceiling	Sqm	0.18
(b)	20 mm. thick.15mm + 5mm (for internal walls	Sqm	0.22
26	Cementplaster in C.M. 1:4, 20mm. thick rough finish (for external brick/concrete surfaces)	Sqm.	0.17
27.	Sand faced plaster, 20mm. thick (12mm C.M. 1:4 + 8 mm C.M. 1:3)	Sqm	0.21
28.	Rough cast plaster, 25 mm thick (12mm C.M. 1:4 + 13 mm C.M.1 :3)	Sqm	0.27
(+)	(+) 10 mm wide & 18 mm thick plain or moulded cement mortar band in CM 1:4	100 R.M	0.152
29.	**Cement plaster in C.M. 1:3 with water proofing compound finished smooth with neat cement**		
(a)	12mm. thick	Sqm	0.19
(b)	20mm. thick	Sqm	0.27
30.	**Cement pointing in C.M. 1:3**		
(a)	Ruled pointing (groove pointing)	Sqm	0.02
(b)	Raised & cut pointing	Sqm	0.04

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
31.	**Cement based waterproofing works (Through the agency approved by the E.I.C)**		
(a)	Terrace type average 115 mm. thick	Sqm	0.45
(b)	Basement type (Box type).	Sqm	0.70
(c)	Basement type (surface).	Sqm	0.60
(d)	In sunken floor of toilets, chajjas, parapets	Sqm	0.30
(e)	Brickbat coba in toilets, extra in roof terrace	Cum	3.00
(f)	O.H. Water tanks	Sqm	0.50
(g)	Expansion joints.	R.M	0.50
32.	**Damp proof course in C.C. 1:2:4**		
(a)	25mm. thick	Sqm	0.16
(b)	38mm. thick	Sqm	0.24
33.	**Laying R.C.C. spun pipes in C.M. 1:1/1:2**		
(a)	100 mm dia.	10m	0.10
(b)	150 mm dia	10m	0.12
(c)	250 mm dia.	10m	0.18
(d)	300 mm dia	10m	0.22
(e)	450 mm dia	10m	0.48
(f)	600 mm dia	10m	0.64
34.	**Cement mortar 1:4 screed**		
(a)	20mm. thick	Sqm	0.16
(b)	50mm. thick	Sqm	0.38
35.	**Chain link fencing/barbed wire fencing - C.C. 1:2:4 pockets of 450x450x600 mm.:**		
(a)	Angle iron posts	m	0.21
(b)	Cement Concrete 1:2:4 posts	m	0.37
36	Kerb stone in CC 1:3:6 of size 125x375mm	m.	0.21
37.	Shahabad stone paving, pointed in C.M.1 :3, 15x10 mm groove.	Sqm	0.02

38	Pointing & grouting stone pitching in C.M. 1:3	Sqm	0.14

APPENDIX – "C-1"

CONSUMPTION OF PAINT FOR SOME PAINTING ITEMS :

(PARA 47.7.1 OF PAINTING)

Coverage Achieved Per Litre or Per Kg of Paint / Material				
Sl. No.	***Name of Paint***	***Area coverage For one coat***	***Area coverage For two***	***Area coverage Per addl.***
1	Synthetic enamel paint	1 4m² per lt.	8.5m² per lt.	1 8m² per lt.
2	Plastic emulsion paint	14m² per lt.	8.5m² per lt.	18m² per lt.
3	Oil Bound distemper	10m² per lt.	6.0m² per lt.	12m per lt.
4	Dry Distemper	10m² per kg	6.5 m² per kg	12 m² per kg
5	White wash	5m² /kg of lime	3.5m² / kg of lime	10 m² /kg of
	Note : Following things to be added in lime (i) Adhesive (DDL/SDL) – 5% of lime			
6	Cement based paint	4.5 m² per kg	2 m² per kg	6 m² per kg
7	Aluminium paint	20m² per lt.	12.5 m² / lt.	28 m² per lt.
8	Bitumen Paint/Black Japan	14 m² per lt.	14 m² per lt.	28 m² per lt.
9	Neeru (or lime punning with slacked lime) over	0.5 m² per kg		
10	Red oxide metal primer	16 m² per lt.		
11	Cement primer	12 m² per lt.		
12	Wood primer	13 m² per lt.		
13	Wax polishing of new wood work with ready	20m² per kg	20m² per kg	20m² per kg
14	French or spirit polish	10.5 m² / lt.		
15	Varnish	14 m² per lt.	8.5 m² per lt.	18 m² per lt.
16	**Requirement of paint per coat in Structural steel work on tonnage basis.** (i) Truss and Lattice girder work – 4.5 litres per tonne.			

APPENDIX – "C-2"

CO-EFFICIENT FOR EQUIVALENT PLAIN AREAS FOR PAINTING ITEMS :

(PARA REFERRED TO CHAPTER 47 - PAINTING)

SN	DESCRIPTION OF WORK	MULTIPLYING CO-EFFICIENTS
I.	**WOOD WORK : DOORS, WINDOWS ETC.**	
1	Panelled or framed and braced doors, windows etc.	
2	Ledged & battened or ledged, battened & braced doors, windows etc.	1.30 (for each side)
3	Flush doors etc	1 .20 (for each side)
4	Part panelled and part glazed or gauzed doors,windows etc.	1.00 (for each side)
5	Fully glazed or gauzed doors, windows etc.	0.80 (for each side)
6	Fully venetioned or louvered doors, windows etc.	1.80 (for each side)
7	Trellis (or Jaffri) work one way or two way.	2.00 (for painting all over)
8	Carved or enriched work:	2.00 (for each side)
9	Weather boarding:	1.20 (for each side)
10	Wood shingle roofing:	1.10 (for each side)
11	Boarding with cover fillets and match boarding.	1.05 (for each side)
12	Tile and slate battening:	0.80 (for painting all over)
II.	**STEEL WORK: DOORS, WINDOWS ETC.**	
13	Plain sheeted steel door or windows:	1.10 (for each side)
14	Fully glazed or gauzed steel doors and windows	0.50 (for each side)
15	Partly panelled and partly gauzed or glazed doors and windows.	0.80 (for each side)
16	Corrugated sheeted steel doors or windows.	1.25 (for each side)
17	Collapsible gates	1.50 (for painting all over)
18	Rolling shutters of inter locked laths.	1.10 (for each side)
III.	**GENERAL WORKS :**	

19	Expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings in guard bars, balusters, railings, partitions and m.s. bars in window frames.	1.00 (for painting all over)
20	Open palisade fencing and gates including standards, braces, rails, stays etc. in timber or steel.	1.00 (for painting all over)
NOTE: The height shall be taken from the bottom of the lowest rail, if the palisades do not go below it (or from the lower end of palisades, if they project below the lowest rail) upto the top of palisades but not upto the top of standards, if they are higher than the palisades.		

SN	**DESCRIPTION OF WORK**	**MULTIPLYING CO-EFFICIENTS**
21	Corrugated iron sheeting in roofs, side cladding etc.	1.14 (for each side)
22	A.C. Corrugated sheeting in roofs, side cladding etc.	1.20 (for each side)
23	A.C. Semi-corrugated sheeting in roofs, side cladding etc. or Nainital pattern using plain sheets.	1.10 (for each side)
24	Wire gauze shutters including painting of wire gauze.	1 .00 (for each side).

* * *

APPENDIX – "D"

PROFORMA FOR GUARANTEE TO BE EXECUTED BY CONTRACTORS FOR STABILITY OF PILE FOUNDATION SYSTEM AGAINST RISK OF SETTLEMENT & OTHER TYPE OF DISTRESS TO THE BUILDING(S).

(PARA 7.7 OF PILE FOUNDATION)

This Agreement made this ..... day of Two thousand ..... between M/s. ..... (hereinafter called the Guarantor of the one part) and the MAZAGON DOCK SHIPBUILDERS LIMITED (hereinafter called the Employer of the other part).

Whereas this Agreement is supplementary to a contract (hereinafter called the Contract) dated..... and made between the Guarantor of the one part and the Employer of the other part whereby the contractor interalia undertook to render the damages caused to the buildings and structure to the satisfaction of the E.I.C.

AND WHEREAS THE GUARANTOR agreed to give a guarantee for the stability of pile foundation system against the risk of settlement and against all damages caused to the buildings erected on pile foundation system for a period of five (5) years from the certified date of completion.

NOW THE GUARANTOR hereby guarantees that the stability of the pile foundation system provided by him will render the structures completely free from settlement and any other type of distress for a period of five (5) years to be reckoned from the certified date of completion of the work.

During this period of guarantee, if the Guarantor fails to execute necessary rendering work due to damages/distress caused to the buildings and structures for settlement of pile foundation system or commits breach thereunder, then the Guarantor will indemnify the principal and successors against all loss, damage, cost, expense or otherwise which may be incurred by the Employer by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Employer, the decision of the Engineer-in-charge shall be final and binding on the contractors.

IN WITNESS WHEREOF these presents have been executed by the Obligator..... ..... and by.....and for and on behalf of the MAZAGON DOCK SHIPBUILDERS LIMITED, Bombay on the day, month and year first above written.

SIGNED, sealed and delivered by (OBLIGATOR) in the presence of :

(1)

(2)
SIGNED FOR AND ON BEHALF OF THE MDL

BY.....in the presence of :

(1)

(2)

APPENDIX – "E"

Contact details for Expansion Joint & Underdeck Insulation

Sr. No.	**Description**		
01	**Underdeck Insulation – BASF**		
	Contact Person Name	Mr. Merlin Nadar	Mr. Koushal Pandey
	Contact No	022 28580290	
	Mobile	+91 97690 61417	91 98333 53984
	Email id	Merlin.nadar@basf.com	koushal.pandey@basf.com
	Office address	BASF India Limited, Plot no. 37, Chandivali farm Road, Chandivali, Andheri (East) Mumbai- 400 072	
02	Expansion Joint - Sanfield		
	Contact Person Name	Kapil Rajwani	
	Contact No	022-26280467/468	
	Mobile	9820421502	
	Email id	kapilrajwani@sanfieldindia.in sanfieldmumbai@sanfieldindia.in	
	Office address	501, Eva Andheri CHS, plot no.10, V.P. road, S.V.Road, Near Shree Ram Road, Andheri (W), Mumbai-58	
	Head Office	13-A, D-sector, Industrial Area, Govindpura, Bhopal- 462 023	
	Contact No	0755-4233535/ 4271571, 4284320	

6 Special conditions for steel

1) The contractor shall procure TMT bars of **Fe415/Fe415D/Fe500D/Fe550/Fe550D** grade (the grade to procured is to be specified) from primary steel producers such as **SAIL, Tata Steel Ltd., RINL, Jindal Steel & Power Ltd.; Essar and JSW Steel Ltd.**

a) The grade of the steel such as **Fe415/Fe415D/Fe500/Fe500D/Fe550/Fe550D** or other grade to be procured is to be specified as per BIS 1786-2008.

2) The contractor shall have to obtain and furnish test certificates to the Engineer-in-Charge in respect of all supplies of steel brought by him to the site of work.

3) Samples shall also be taken and got tested by the Engineer-in-Charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications defined under para (1)(d) & (1)(e) above, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time or written orders from the Engineer-in-Charge to do so.

4) The steel reinforcement bars shall be brought to the site in bulk supply of 10 tonnes or more, or as decided by the Engineer-in-Charge.

5) The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

6) For checking nominal mass, tensile strength, bend test, re-bend test etc. specimens of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below:

Size of bar	**For consignment below 100 tonnes**	**For consignment above 100 tonnes**
Under 10mm dia bars	One sample for each 25 tonnes or part thereof	One sample for each 40 tonnes or part there of
10mm to 16mm dia bars	One sample for each 35 tonnes or part thereof	One sample for each 45 tonnes or part there of
Over 16mm dia bars	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part there of

7) The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor.

8) The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause of the contract. The theoretical

consumption of steel shall be worked out as per procedure prescribed in clause of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible no adjustment need to be made.

Note:-

If the Contractor wishes to suggest minor improvements/changes in the technical parameters without changing the major Contract technical specification, then the same need to be informed to the Consultant and Client for consideration with proper justification. However, the Consultant's and Client's decision will be full and final and binding on the Contractor.

II

PLUMBING WORK TECHNICAL SPECIFICATION

II - PLUMBING WORK TECHNICAL SPECIFICATION

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II- GENERAL TECHNICAL SPECIFICATION FOR PLUMBING WORK

1.0 GENERAL:

1.1 The work shall be carried out in the accordance with the drawings and design as would be issued to the Contractor by Client or Consultant duly signed and stamped by him. Similarly, the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Client's Representative in writing.

1.2 The work shall be executed and measured as per metric dimensions given in the Bill of Quantities, drawings etc.

1.3 The Contractor shall acquaint himself fully with the partial provisions for supports that may or may not be available in the structure and if are available then utilize them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that they have been already made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.

1.4 Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.

1.5 The Contractor shall protect / handle the material carefully and if any damage occurs while handling by the Contractor then the sole responsibility shall be of the Contractor. Such damages shall be rectified/recovered by the Contractor at no extra cost whatsoever.

1.6 MEASUREMENTS:

All measurements shall be taken in accordance with relevant IS codes, unless otherwise specified.

2.0 APPLICABLE CODES AND STANDARDS:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.

Plumbing Works:

Vitreous Chinaware	-	IS: 2556 - 1974 (Part - I)
	-	IS: 2556 - 1981 (Part - II)
	-	IS: 2556 - 2556 (Part - III)
Ball Valve	-	IS: 1703 - 1977
Cistern Brackets	-	IS: 775 - 1970
Toilet Seat Cover	-	IS: 2548 - 1983
Vitreous China Cistern	-	IS: 2326 - 1987
Sand Cast Iron Pipes and Fittings	-	IS: 1729 - 1979
Spun Cast Iron Pipes and Fittings	-	IS: 3989 - 1984
GI Pipes	-	IS: 1239 - 1979

Galvanizing for GI Pipes	-	IS: 4736 - 1986
Pipe Threads	-	IS: 554 - 1985
Milleable Iron Fittings	-	IS: 1879 - 1987
Cast Iron Sluice Valves	-	IS: 780 - 1984
Full Way Valves	-	IS: 778 - 1984
Brass Ferrule	-	IS: 2692 - 1978
Stone Ware Gully Trap	-	IS: 651 - 1980
RCC Pipes	-	IS: 458 - 1971
Cast Iron Class LA Pipes	-	IS: 1536 - 1989
Cast (Spun) Iron Fittings	-	IS: 1538 - 1976
Pig Lead	-	IS: 782 - 1966
Induction Motors	-	IS: 4691
Code for Measurements	-	IS: 1200
UPVC Pipes and Fittings	-	IS: 4984
Specification for Caulking Lead	-	IS: 782
Code of Practice for laying of concrete	-	IS: 783

3.0 QUALITY ASSURANCE AND QUALITY CONTROL:

3.1 The work shall conform to high standard of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the quality assurance and quality control system.

3.2 At the site, the Contractor shall arrange the materials and their stacking/ storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of material, assemblies etc. as directed by the Client's Representative. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.

3.3 The Client's Representative shall be free to carry out such tests as may be decided by him at this sole direction, from time to time, in addition to those specified in this Document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.

3.4 The test shall be conducted at Standard Laboratory selected by Client's Representative. Contractor shall keep the necessary testing equipment such as hydraulic testing machine, smoke testing machine, gauges and other necessary equipment required.

3.5 The Client's Representative shall transport the samples to the laboratory.

3.6 Testing charges shall be borne by the Client's Representative.

3.7 Testing may be witnessed by the Contractor or his Authorised Representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

4.0 SANITARY FIXTURES & C.P. FITTINGS:

4.1 SCOPE

4.1.1 Work under this section shall consist of transportation, furnishing, installation, testing and commissioning and all labour as necessary as required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Bill of Quantities.

4.2 GENERAL REQUIREMENTS

4.2.1 All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings or not.

4.2.2 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural design requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.

4.2.3 Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Client's Representative.

4.2.4 All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows on the drawings & in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, wall or ceiling surfaces shall be made good at Contractors cost.

4.2.5 All fixtures of the similar materials shall be by the same manufacturers.

4.2.6 All fitting shall be of the chromium plated materials.

4.2.7 Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.

4.7.8 Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, and hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.

4.7.9 For the installation of the CP fittings, Teflon tape shall be used.

4.3 EUROPEAN W.C.

4.3.1 European W.C. of glazed vitreous china shall be wash down, single or double symphonic type, floor or wall mounted set, flushed by means of flush valve as specified in Bill of Quantities. Flush pipe / bend shall be connected to the W.C. by means of suitable rubber adopter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

4.3.2 Each W.C. seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of white solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.

4.3.3 Flush valves shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.

4.3.4 The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.

4.3.5 Alternatively if flushing cistern to be used shall conform to the requirements of IS: 774-1971. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Client/Architect/ Consultant. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.

4.3.6 The levels of the WC should be checked by placing sprit level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out. The fixing will have to be rectified / re-aligned.

4.4 KITCHEN / PANTRY SINKS

4.4.1 Sinks shall be of stainless steel material as specified in the Bill of Quantities/Drawings.

4.4.2 Each sink shall be provided with R. S. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Client's Representative.

4.4.3 Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bill of Quantities/Drawings.

4.5 WASH BASINS

4.5.1 Wash basin shall be of white vitreous china of best quality manufactured by an approved firm and sizes as specified in the Bill of Quantities.

4.5.2 Wash basin shall be of under counter drop in type shall be supported on a pair of rolled steel brackets of approved design and shall be mounted on a countertop. So that rim and basin bowl is exposed from top.

4.5.3 Wash basin shall be provided with single lever mixer with chain and rubber plug, chromium plated brass bottle trap of approved quality, design and make where hot water required. Single tap where hot water is not required.

4.5.4 Wash basin shall be fixed at proper location and height and truly horizontal as shown on drawing or as directed by Client's Representative.

4.6 HOSE BIBB'S

4.6.1 Hose Bib of Chromium Plate tap is draw off tap with horizontal inlet and free outlet knurling on outer face to fix the hose pipe. Hose bib shall be of specified size and shall be of screw down type and shall conform to IS: 781-1984. The closing device shall work by means of a disc carrying a renewable non-metallic washer which shuts against the water pressure on a seating at right angle to the axis of the threaded spindle which operate it. The handle shall be either crutch or butterfly type securely

4.7 URINALS

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia, C.P. brass spreader, 32mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers complete as directed by the Client's Representative.

Urinals shall be flushed by means of "NO-TOUCH" infrared operated flush valves.

Waste pipes for urinals shall be any one of the given material as directed by the Client's Representative:

a) G.I. Pipes
b) Rigid PVC/High density polyethylene.

Waste pipes may be exposed on wall or concealed in chase as directed by the Client's Representative.

4.8 BATH TUB

Bath tub & panel shall be white enameled cast iron or pressed steel as specified in the Bill of Quantities of guaranteed quality and specifications.

Each bath tub shall be provided with 40mm dia CP brass waste with 32mm C.P. brass overflow, 40mm dia cast brass overflow-cum-waste trap with pop-up waste assembly.

Bath tub shall be provided with four Nos. C.P. brass concealed stop cocks, bath spout and overhead shower or as specified in the Bill of Quantities.

Bath tubs shall be fixed true to level firmly fixed to another or supports provided by the manufacturer. Edges touching the wall shall be slightly recessed in the wall finishing so as ensuring water tightness. The fixing shall be perfectly done so that the wall behind does not tend to get damp or patchy.

Contractor shall during the entire period of installation and afterwards protect the bathtub by providing suitable cover or any other protection so as to absolutely prevent any damage to the bathtub until handing over.

4.9 MEASUREMENTS

4.9.1 Rate for providing and fixing of sanitary fixtures, accessories, urinal partitions shall include all items and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable.

4.9.2 Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangement required.

5.0 WATER SUPPLY:

5.1 SCOPE

5.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the bill of quantities.

5.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

i. Pipe protection & painting.

ii. Connections to all plumbing fixtures, tanks, pump etc.

iii. Providing hot water pipe lines and supply point with isolation valves, wherever required.

iv. Control valves, masonry chambers and other appurtenances.

v. Connections to all plumbing fixtures, tanks and appliances.

vi. Excavation and refilling of pipe trenches, wherever necessary.

vii. Internal galvanized water supply piping inside the toilets shaft/plant room/terrace.

viii. Testing all line and fixtures as specified.

5.2 GENERAL REQUIREMENTS:

5.2.1 All materials shall be new of the best quality and shall be furnished, delivered, erected, connected and finished in every detail conforming to specifications and subject to the approval of Client's Representative.

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

5.2.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

As far as possible all bends shall be formed by means of hydraulic pipe bending machine for pipes up to 65mm dia.

5.2.4 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc. and shall be selected and arranged so as to fit properly into the allocated building space.

5.2.5 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.

5.2.6 Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

5.2.7 Connection between dissimilar materials.

5.2.8 All G.I. pipes jointing shall be with white lead and spun yarn.

5.2.9 Drawings illustrating block out and penetration of pipes in the wall/floor/slab.

5.2.10 UNIONS:

Contractor shall provide adequate no. of unions on all pipes to enable dismantling later and for servicing. Union shall be provided near each gunmetal valve.

5.3 INTERNAL WORKS

5.3.1 MATERIALS:

5.3.1.1 G.I. PIPES

i. The pipes shall be galvanised mild steel threaded pipes conforming to the requirement of IS: 1239 Part-I for heavy grade upto 150mm dia and IS: 3589 for pipes above 150mm dia. They shall be of the dia (nominal bore) specified in the description of the item. Galvanising shall confirm to IS: 4736.

ii. The pipes shall be clearly finished, well galvanised in and out and free from cracks, surface flow, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with axis of the tube.

iii. All screw tubes shall have pipe threads conforming to the requirements of IS: 544-1955 (or revised).

5.3.1.2 G.I. FITTINGS

i. All fittings shall be conforming to IS: 1239 Part II (or as revised). All fittings shall have manufacturer's trade mark stamped on it. Fittings in G.I. pipe lines shall include elbows, tees, bends, reducers, nipples, union, G.I. Clamps / Steel structural supports of approved design, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Contractors may be required to produce certificate to this effect from the manufacturers.

ii. The fittings shall have screw threads at the ends conforming to the requirements of IS: 544-1955 (or revised). Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

5.3.1.3 CUTTING AND JOINTING:

i) The pipes and fittings shall be inspected at site before use to ascertain that they conform the specification given in para no. 5.3.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded conforming to the requirements of IS: 544-1955 with pipe dies and taps carefully is such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bend or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in water tight joint.

ii) The screw threads of pipes and fittings shall be protected from damage until they are fitted.

iii) The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket. Care should be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free dust and dirt during the fixing. Burr from the joint shall be removed after laying. The open ends of the pipes shall be temporarily plugged to prevent access of water, solid or any other foreign matter.

5.3.2 INSTALLATION OF G.I.:

Tender drawings indicate schematically the size and location of pipes. The Contractor on the award of the work, shall prepare detailed coordinated with other trades working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.

i. Piping shall be properly supported on or suspended from connection clamps, hangers as specified and as required. Install pipes in a manner to avoid strain on equipments connections. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their structural sufficiency.

ii. Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials a dielectric fitting shall be provided in between. Spacing of pipe supports shall not exceed the following:

Pipe Size	**Spacing between Supports**
Upto 12 mm	1.5 meter
15 to 25 mm	2.0 meter
32 to 150 mm	2.0 meter
150 mm and over	2.5 meter

iii. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.

iv. Pipe sleeves, 50 mm larger diameter than pipes, and 50mm above F.FL. Shall be provided wherever pipes pass through walls and slabs, and annular space filled with fire proof materials like putty, fire seal etc.

v. All pipe work shall be carried out in workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation also coordinated with other Contractors work so that particular area work shall be carried out in one stretch.

vi. Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut outs provided and clearly point out wherever the cut outs shown in the drawings, do not meet with the requirements.

vii. The Contractor shall make sure that the clamps, steel structural supports, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes, and include expansion joints where required.

viii. All pipes shall be accurately cut to the required sizes in accordance with

relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.

ix. All buried pipes shall be cleaned and coated with zinc chromate primer and bitumen paint, then wrapped with bitumen faced hesian.

x. In case the pipe is embedded in walls or floors, it should be painted with two coats of anti corrosive bitumastic paint of approved quality, covered with one layer of fiberglass tissue and finally painted with one coat of bitumen paint. The pipe should not come in contact with cement mortar or cement concrete as the pipe will be affected by cement. Under the floors, the pipes shall be laid in layer of filling under concrete floors.

xi. For pipes 15mm to 25mm dia, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Client's Representative. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) properly finished to match the adjacent surface.

xii. All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code/or as specified by the Client's Representative.

xiii. Springing or forcing pipe into place will not be permitted. Protect piping at all times from dirt and moisture. During storage at construction site, keep end plugged to prevent dirt and moisture entering.

xiv. Carefully grade all pipes to eliminate traps and pockets. Where air pockets or water traps can not be avoided provide means of drainage with valved hose connection for water traps and valved automatic air vents for air pockets.

xv. Below grade piping shall be installed in such a manner that it does not appear directly on ground.

xvi. Any location where pipes/valves through or closed to basement walls shall be protected from direct contact of concrete block.

xvii. Pipes passing through building walls shall be protect by cast iron sleeves large enough to permit changes size eccentric fittings shall be used except where branch pipes connect into mains and in domestic system.

5.3.3 INSULATION:

- All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.

- Insulating material shall be rigid performed sections of mineral/rock wool with a "K" value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m

- No insulation shall be applied until the pipe is satisfactorily pressure tested.

- Pipes shall be insulated with rigid performed pipe sections of the following

thickness:

Pipe Diameter (mm)	Thickness (Mineral Wool) mm
80-150	50

- Pipe insulation shall be applied as follows:
- Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of anti-rust paint.
- Pipes in Shaft:

  i) Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).

  ii) The insulation shall be tied with GI chicken wire mesh.

  iii) The insulation shall be provided with 24 gauge aluminium cladding screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.

- Pipes exposed to weather:

  i) Same as (b) (i) to (ii)

  ii) Provide polythene based hessian (500 gauges) overlapping 100mm on all joints (transverse and circumferential) and stitched at the joints.

  iii) The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.

  iv) Over the wire mesh the surface shall be covered with two layers of tarfelt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).

  v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

  vi) Over the final layer of tarfelt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tapings screws. Joints shall be overlapped minimum 25mm wide.

  d) Pipes Buried Underground:

  i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).

  ii) The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.

  iii) Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.

iv) The polythene surface shall be covered with two layers of tarfelt grade – II, type – II with bitumen between layers overlapped 100mm on all joints (transverse and circumferential).

v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

5.3.4 TESTING:

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm which ever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.3.5 PAINTING:

The pipes shall be finally provided with synthetic enamel paint of approved quality for exposed pipes after the Hydrostatic test pressure. The cost of such painting should be included to the Contractor's quote.

5.3.6 MEASUREMENTS:

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc... Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

5.4 EXTERNAL WORKS:

5.4.1 MATERIALS:

5.4.1.1 G.I. PIPES

i. The pipes shall be galvanised mild steel threaded pipes conforming to the requirement of IS: 1239 Part-I for heavy grade upto 150mm dia and IS: 3589 for pipes above 150mm dia. They shall be of the dia (nominal bore) specified in the description of the item. Galvanising shall confirm to IS: 4736.

ii. The pipes shall be clearly finished, well galvanised in and out and free from cracks, surface flow, laminations and other defects. All screw threads shall be

clean and well cut. The ends shall be cut cleanly and square with axis of the tube.

iii. All screw tubes shall have pipe threads conforming to the requirements of IS: 544-1955 (or revised).

5.4.1.2 G.I. FITTINGS

i. All fittings shall be conforming to IS: 1239 Part II (or as revised). All fittings shall have manufacturer's trade mark stamped on it. Fittings in G.I. pipe lines shall include elbows, tees, bends, reducers, nipples, union, G.I. Clamps / Steel structural supports of approved design, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Contractors may be required to produce certificate to this effect from the manufacturers.

ii. The fittings shall have screw threads at the ends conforming to the requirements of IS: 544-1955 (or revised). Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

iii. Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each gunmetal valve, stop cocks, or check valves and on straight runs as necessary at appropriate locations as required and/or directed by Client's Representative.

5.4.1.3 CUTTING AND JOINTING:

i) The pipes and fittings shall be inspected at site before use to ascertain that they conform the specification given in para no. 5.4.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded conforming to the requirements of IS: 544-1955 with pipe dies and taps carefully is such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bend or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in water tight joint.

ii) The screw threads of pipes and fittings shall be protected from damage until they are fitted.

iii) The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket. Care should be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free dust and dirt during the fixing. Burr from the joint shall be removed after laying. The open ends of the pipes shall be temporarily plugged to prevent access of water, solid or any other foreign matter.

5.4.1.4 INSTALLATION:

i) Trenches :

The galvanised iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in Table below:-

Dia of pipe trench	Width of trench	Depth of
15 mm to 50 mm	30 cm	60 cm
65 mm to 150 mm	45 cm	75 cm

At joints the trench width shall be widened where necessary. All G.I. / C.I. pipes below ground in trenches minimum cover over pipes shall be 60cm. Covered shall be measured from top of pipe to the surface of ground. The bed of the trench if in soft or made up earth, shall be well watered and rammed before laying the pipes and depressions if any shall be properly filled with earth and consolidated in 20cm layers.

If the trench bottom is extremely hard and rocky or loose stony soil, the trench shall be excavated at least 150mm below the trench grade. Rocks, Stone or other hard substances from the bottom of the trench brought back the required grade by filling with selected fine earth or sand and compacted so as to provide smooth bedding for the pipe. When excavation required blasting operation, it shall be ensured that no pipes have be stacked in the vicinity and completed pipe in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipe in the vicinity by falling stone as result of blasting.

After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrel of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces lift for jointing the under side of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

Roots of tree within distance of about 0.5 meter from the side of the pipe line shall be removed or killed.

The excavated materials shall be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The material excavated shall be separated and stacked so that in refilling they may be re-laid and completed the same order to satisfaction of the Client's Representative.

The filling shall be done in layers not exceeding 15mm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of the crow brass where rammers can not be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.

Filling in trenches shall be commenced soon after the joints of pipes, cables; conduits etc. have been tested and approved by Client's Representative. The space around the pipes shall be cleared of all debris where the trenches are excavated in hard/soft soil. The filling shall be done with earth on the sides and tops of pipes in layers not exceeding 15mm in depth. Each layer shall be watered rammed and consolidated. The clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the excavated earth is used for filling. Generally no test is done to determine the instrument diversity of filled earth but on the discretion of Client's Representative the 95 proctor's compaction test may be done to ensure the in situ density after filling. Consolidation is removal of water from the pores and compaction is the explosion of air from the pores. In case of refilling consolidation places most important role as the watering of the each layer is being done properly. If required by the Client's Representative proctors needle may also be used for the

proper checking of the refilling items of in situ density.

ii) Pipe Protection:

For underground G.I. pipes following treatment will be given:

Coat of hot bitumen R 85/25

a) Wrapping of fiberglass tissue.

b) Coat of hot bitumen R 85/25 over fiberglass tissue.

The pipes shall be laid on a layer of 7.5 cm sand and filled upto 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth. The surplus earth shall be disposed off as directed.

iii) Jointing :

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped around the screwed end of the pipes. The end shall then be screwed in the socket, tee etc with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joints shall be removed after screwing. After laying, the ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

iv) Thrust Blocks :

In case of bigger pipes (80 mm dia and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Client's Representative.

5.4.1.5 TESTING:

i. All external water supply pipes shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more.

ii. Pressure shall be maintained for a period of at least 180 minutes without any drop in the pressure after fixing at site.

iii. In addition to the sectional testing carried out during the construction. Contractor shall test the entire installation after connections to the hydropneumatic system or pumping system. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to careless will has to be replaced by the Contractor.

iv. The initial back fill shall be placed evenly in a layer of about 100mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300mm of cover over the pipe.

v. The joint or coupling during the testing of mains shall be left exposed for inspection before cover-up, sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing. In this way if any error if workmanship will be found shall immediately corrected at a minimum cost.

5.4.1.6 MASONRY CHAMBER:

i) All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.

ii) The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Client's Representative.

iii) Concrete shall be having cement concrete 1:2:4 (1 cement: 2 fine sand: 4 graded stone aggregate 40mm nominal size).

iv) Brick shall be in 1st class bricks in cement mortar 1:5 (1 cement: 5 fine sand).

v) Plastering not less than 12mm/15mm thick shall be done in cement mortar 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement for inside plaster and same for outside but with Rough plaster.

5.4.1.7 MEASUREMENTS:

All G.I pipes below ground shall be measured per linear meters (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, deduction for valves shall be made rate quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chase and making good all item mentioned in Bill of Quantities.

All C.I. class (LA) pipes below ground level shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. tees, elbows, bends, deduction for valves shall be made. The portion of the pipe within the collar at the joints shall not be included in the length of the pipe work. Rate quoted shall be inclusive of all fittings, excavation, back filling of surplus earth including consolidation and compaction of earth.

5.5 VALVES:

5.5.1 BUTTERFLY VALVES:

All the isolation valve 50cm and above on the equipment and water lines, where specified or shown on drawings shall be wafer type butterfly valves. They shall be designed to fit without gaskets, the water tight seal being obtained by EPDM seat projection at the faces compressed between the flanges. The valves shall be supplied inclusive of M.S. pipe flanges and high tensile steel bolts of dimensions recommended by suppliers of valves. The valves shall comply with following specifications:

a)	Test Pressure	: Body 24 Bar, Seat 16 Bar
b)	Valve Component	: Material of Construction
i)	Body	: Cast Iron, Gr. FG 260, IS:210
ii)	Disc Gr, FG 260	: Nylon or Epoxy powder coated high duty iron,
iii)	Stem	: Stainless Steel or carbon steel IS: 1570, Part-II.
iv)	Seat	: EPDM
v)	Hand Lever	: Cast Iron (Mechanical Memory Stop)

vi)	Bearings	: PTFE or Nylon covered S.S. bush bearings at stem and pivot.
vii)	Primary Seal	: Reinforced PTEE slide bearings
viii)	Temperature	: 80 Degree C (max.)

5.5.2 INSTALLATION:

Valve shall be installed in a manner that allows future removal and service of the valve.

Packing and gasket shall not contain asbestos.

The valve shall be of the same size as the pipe to which they are installing.

Valve above 150mm diameter shall be self locking warm gear type water proof and protory lubricated.

Provide chain operators with chain cleats for all valves more than 2.4 meters above floor.

5.5.3 NON RETURN VALVES:

All non-return valves shall be provided as shown in the drawings conforming to relevant Indian Standards and in accordance with the following specifications.

Size	**Construction**
Ends	
Up to 50 mm. Screwed	Gun metal
65 mm and above flanged	Gun metal/cast iron

Non-return valves shall be of approved make. Flap type non-return valve shall be used and tested to 15 Kg. / Sq.cm. pressure.

5.5.4 BALL VALVES (FLOAT VALVE):

The ball valve shall be of high pressure class and shall be confirm to IS: 1703 of sizes as specified. The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball shall be of brass or gun metal as specified and the float shall be of polythene sheet. The minimum gauge of copper sheet used for making the float shall be 0.45mm for float upto 115mm dia and 0.55mm for float exceeding 115mm dia and shall be special in shape. The valve shall be constructed to permit replacing without console of the valve body from the valve line and the system shall not blow out under pressure. The jointing of the float shall be made by efficiently burnished, lapped and soldered seam or by bracing. Plastic float may also be used if specified. The body of ball valve when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 10.5 Kg/Sq.cm. All ball valves shall be capable of withstanding a pressure of 14 Kg/Sq.cm.

The ball valve shall generally conform to IS specifications No. 1703-1962.

5.5.5 BALL VALVES:

The ball valve shall be of Brass or Gunmetal as specified conforming to IS: 1703. The ball valve shall be as given below:

High Pressure:
Indicated by the abbreviation 'HP' for use on mains having pressure. These shall remain closed at a test pressure of 10.5 Kg/Sq.cm.

SL. NO.	NOMINAL SIZE OF BALL VALVE					
	15 mm	20m	25m	32m	40m	50m
1. Diameter of spherical float (mm)						
High Pressure	127	152	203	229	254	305
Low Pressure	114	127	178	203	203	254
Minimum weight of ball valve including back nut, body and piston (gms)	283	446	823	1149	1589	1852

The ball valves shall be of following nominal sizes 15mm, 20mm, 25mm, 32mm, 40mm and 50mm. The nominal size shall correspond with the nominal bore of the inlet shanks.

5.5.6 AIR VALVES:

Air valves shall be provided in all high points in the system to prevent air locks as shown on the drawings or directed by Client's Representatives.

5.5.7 TESTING:

All valves shall be tested while installed in pipe by hydrostatic pressure of 1.5 time of the working pressure 7.5 Kg/Sq.cm which ever is more.

5.5.8 MEASUREMENTS:

All valves as mentioned in Bill of Quantities shall be measured by numbers and shall include all items mentioned in the Bill of Quantities.

5.6 CHLORINATION OF DOMESTIC WATER LINES:

5.6.1 After the completion of all the hot and cold water service piping, disinfect all the fresh water supply work and water reservoirs using a chlorine solution.

5.6.2 CHLORINATED SYSTEMS SHALL INCLUDE:

i. Domestic fresh water tanks
ii. Fire water tanks
iii. All pipe work systems receiving suction from the above mentioned tanks apart from the fire systems.

5.6.3 Before handover of the system, submit to the consultant copies of the certification of performance and laboratory report (if required)

5.6.4 Under no circumstances the use of any portion of the fresh water system until it is properly disinfected, flushed and certified shall be permitted.

5.6.5 During the Chlorination work the Contractor shall take all necessary precautions to prevent site staff from drinking the system water. Such precautions shall include looking doors to 'wet' areas and providing warning signs in English and Hindi.

5.7 CPVC PIPES & FITTINGS:

i. The pipes and fittings chemically known as Chlorinated Poly Vinyl Chloride [CPVC] shall be produced in Copper Tube Size [CTS] from ½" to 2" with two different standard dimensional ratios – SDR 11 and 13.5. The fittings shall be produced as per SDR 11. All the CPVC pipes and fittings in SDR 11 and SDR 13.5 shall be made from the identical CPVC compound having the same physical properties. Pipes and fitting shall be produced as per SDR 11 & shall meet the requirement of ASTM D 2846 where as the pipes produced with SDR 13.5 shall meet the requirement derived from ASTM F 442, specific to CPVC in Iron Pipe Size[IPS] dimension, which also shall be applied to CPVC pipes in Copper Tube Size[CTS] dimension.

5.7.1. CUTTING AND JOINTING AND INSTALLATION OF CPVC PIPES & FITTINGS:

i. CUTTING:

In order to make a proper and neat joint, the pipe length shall be measured accurately and make a small mark. Ensure that the pipe and fittings are size compatible. It shall be easily cut with a wheel type plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible shall provide optimal bonding area within a joint.

ii. DEBURRING / BEVELING:
Burrs and filings shall prevent proper contact between tube and fitting during assembly and should be removed from the outside and inside of the pipe. A pocket knife or file shall be used for this purpose. A slight bevel on the end of the tubing shall ease the entry of the tubing into the fitting socket.

iii. FITTING PREPARATION:
Using a clean, dry rag, wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

iv. SOLVENT CEMENTS APPLICATION:
Use only CPVC cement or an all – purpose cement conforming to ASTM -493 or joint failure may result. When making a joint, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged water ways.

v. ASSEMLY:
Immediately insert the tubing into the fitting socket, rotate the tube ¼ to ½ turn while inserting. This motion will ensure and even distribution of cement within the joint. Properly align the fittings. Hold the assembly for approximately 10 seconds, allowing the joint to set-up.

vi. SET AND CURE TIMES:
Solvent cement set and cure times are a function of pipe size, temperature and relative humidity. Curing time is shorter for drier environments, smaller sizes and higher temperatures. It requires 10 to 20 minutes for perfect joint.

vi. CEMENTING:

- Verify the cement is the same as the pipes and fittings being used.
- Check the temperature where the cementing will take place.
  - Cement takes longer time to set up in cold weather. Be sure to allow extra time for curing. Do not try to speed up the cure by artificial means – this could cause porosity and blisters in the cement film.
  - Solvents evaporate faster in warm weather. Work quickly to avoid the cement setting up before the joint is assembled. Keep the cement as cool as possible. Try to stay out of direct sunlight.
- Keep the lid on cements, cleaner and primers when not in use. Evaporation of the solvent will affect the cement.
- Stir or shake cement before using.
- Use ¾" dauber on small diameter pipes, 1 ½" dauber up through 3" pipe, and a natural bristle brush, swab or roller ½ the pipe diameter on pipes 4" and up.
- Do not mix cleaner or primer with cement.
- Do not use thickened or lumpy cement. It should be like the consistency of syrup or honey.
- Do not handle joints immediately after assembly.
- Do not allow dauber to dry out.
- Maximum temperature allowable for CPVC pipe is 180^{o} F.
- All colored cements, primers and cleaners will have a permanent stain. There is no known cleaning agent.
- Use according to the step outline in ASTM D – 2846, joining of pipe and fittings.

5.7.2 TESTING

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm which ever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.7.3 MEASUREMENTS

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc... Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

5.8 COMPOSITE PIPES & FITTINGS :

(a) The pipe shall conform to IS 15450 2004 having welded aluminium tube reinforcement between inner & outer polyethylene layers being bonded to aluminium tube by a melt adhesive with welded aluminium tube. The pipe dimensional detail shall be :

Nominal pipe size	Equivalent NB size	Wall thickness in mm	
ID : OD	In inch.	Minimum	Maximum
12:16	½	1.75	2.00
16:20	¾	2.00	2.25
20:25	1	2.45	2.70
25:32	1x1/4	2.80	3.20
32:40	1x1/2	3.40	3.80

(b) The test pressure rating shall be as below :

Nominal pipe size	**Minimum Burst Pressure**
ID : OD	in kg per sq.cm
12:16	60
16:20	50
20:25	40
25:32	40
32:40	35

(c) The internal test pressure rating for fittings shall be as below :

Nominal pipe size	**Minimum Burst Pressure**
ID : OD	in kg per sq.cm
12:16	34.30
16:20	26.70
20:25	26.70
25:32	23.00
32:40	22.30

(d) The fittings shall withstand the following condition & the manufacturer shall submit the test certificate for the following:

Test Temperature : 83 deg Celcius
Test Pressure : 3.5 kg per sq.cm.
Test duration : 3000 hrs.

(e) Jointing:

Jointing shall be done by using proper fittings. Prper tools shall be used for the same

(f) Installation:

The pipe bending shall be done by using proper supports springs, either internal or external. The bending radius shall not be less than 5 times the OD of the pipe.

For concealed piping no supports shall be required but for exposed piping, the spacing of supports shall be as below:

The test pressure rating shall be as below:

Nominal pipe size	Support spacing for horizontal pipe lines	Support spacing for vertical pipe lines
ID : OD	in mtr.	In mtr.
12:16	0.80	1.00
16:20	0.80	1.00
20:25	1.00	1.00
25:32	1.20	1.20
32:40	1.20	1.20

5.8.1 INSULATION

5.8.1.1 All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.

5.8.1.2 Insulating material shall be rigid performed sections of mineral/rock wool with a "K" value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m

5.8.1.3 No insulation shall be applied until the pipe is satisfactorily pressure tested.

5.8.1.4 Pipes shall be insulated with rigid performed pipe sections of the following thickness:

Pipe Diameter (mm)	**Thickness (Mineral Wool) mm**
80-150	50

5.8.1.5 Pipe insulation shall be applied as follows OR AS SPECIFIED IN BOQ:

Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of anti-rust paint.

a) Pipes in Shaft:

I) Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).

ii) The insulation shall be tied with GI chicken wire mesh.

iii) The insulation shall be provided with 24 gauge aluminium cladding screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.

b) Pipes exposed to weather:

i) Same as (a) (i) to (ii)

ii) Provide polythene based hessian (500 gauges) overlapping 100mm on

all joints (transverse and circumferential) and stitched at the joints.

iii) The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.

iv) Over the wire mesh the surface shall be covered with two layers of tarfelt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).

v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

vi) Over the final layer of tarfelt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tapings screws. Joints shall be overlapped minimum 25mm wide.

c) Pipes Buried Underground:

i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).

ii) The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.

iii) Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.

iv) The polythene surface shall be covered with two layers of tarfelt grade – II, type – II with bitumen between layers overlapped 100mm on all joints (transverse and circumferential).

v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

5.8.1.6 TESTING

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm which ever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

5.9. Copper Pipes & Fittings

The pipes shall be hard tempered copper pipes and tubes confirming to requirements of BS 2871 Table 'X' Part -1-1971 and the fittings shall confirm to BS 864 Part 2.
The fittings shall be as follows:

a. Internal Solder Ring (ISR) fitting: For pipes from 15 mm to 35 mm dia.
b. Endex Fittings: For pipes from 42 mm to 54 mm dia.
c. End brazes Fittings: For pipes from 67 mm dia and above.

Fabricated fittings in NO case shall be allowed. Fittings of all types such as Tees, Crosses, Elbows, Reducers, Unions, Off Sets etc. shall be used on the pipes. Suitable fittings of approved type and make shall be used for jointing copper pipes to GI pipes and for-jointing copper pipes to CP fittings etc. shall be used. Use of DZR fitting shall be made for all connections.

Laving: and .Jointing: Of Copper Pipes and Capillary Fittings

The copper" pipes and fittings shall run in wall chase or ceiling or as specified, The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 mm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts, etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes inlays are buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative I Architect, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be covered with a protective tape wrapped around the pipes and fittings.

Copper pipes shall be jointed with approved above mentioned fitting conforming to BS 864 Part 2. Care shall be taken to remove any burr from the end of the pipes after cutting. Only fittings of the size suitable to the pipe shall be used. The ends of the tube shall be cut to the correct size using a tube cutter or a fine blade hacksaw. Care shall be taken to ensure that the ends of the tube are cut perpendicular to the axis of the tube and that the ends remain undamaged and free of burrs. Any burrs remaining shall be removed with a smooth file. Clean the outside surface of the tube that shall go into the fitting. Flux shall be applied on the pipe surface ensuring even and uniform application. Insert the tube into the fittings and push home until the stop is reached. Wipe off excess flux with a soft cloth. Now the assembled joint shall be heated with a blow torch or any similar appliance that emits a clean, blue, soot free flume. The heat shall be turned off once a complete ring of solder has appeared around the mouth of the fitting.

The joint shall be allowed to cool without disturbance.

All copper pipes to G.I. pipe and connection with the valves and faucets shall be with De-zincified Resistance fittings (DZR).

5.10. ASTM - PVC PIPES & FITTINGS

5.10.1 SCOPE:

This specification covers the requirements for manufacture, supplying, lowering, laying, jointing, testing and commissioning of ASTM solvent welded PVC pipe with fittings for the conveyance & distribution system for above ground as well as below ground installation with required civil work.

5.10.2 CODES & STANDARDS:

The manufacturing, testing, supplying, jointing and testing at work sites of PVC pipes shall comply with all currently applicable statutes, regulations, standards and codes. in particular, the following standards, unless otherwise specified herein, shall be referred.

5.10.3 MATERIALS

ASTM D 1785 SCH	-	Specification for Poly Vinyl Chloride (PVC) Plastic Pipes, 40 & SCH 80.
ASTM D 2466	-	Socket type Vinyl Chloride Plastic Pipe Fittings SCH 40
ASTM D 2467	-	Socket type Vinyl Chloride Plastic Pipe Fittings SCH 80
ASTM D 2564	-	Solvent Cement for Plastic Pipes & Fittings
ASTM D 2774	-	Underground installation of Thermo plastic Pipes

5.10.4 DESIGN

Design of uPVC pipes shall be according to ASTM D-1785 & fittings shall be made according to ASTM D-2467 (for Schedule 80). The pipe shall have socketed solvent welded fittings.

5.10.5 TRENCHING

5.10.6 The width of the trench at the crown of the pipe shall be not less than the outside diameter of pipe plus 300 mm to allow proper compaction of the side fills & at a 225 mm above the crown of the pipe. The trench width shall be as below :

NOMINAL PIPE SIZE (IN MM)	TRENCH WIDTH MIN. (IN MM)	TRENCH WIDTH MAX. (IN MM)
110	450	600
160	450	600
200	600	700
225	600	700
250	600	700
315	700	850
355	750	900
400	800	950
450	850	1000

5.10.7 The minimum trench depth shall be width plus outer diamter of pipe or 0.75 mtr. above crown of pipe whichever is more.

5.10.8 The trench shall be backfilled as soon as possible.

5.10.9 The excavated material shall be deposited at a sufficient distance away from the edge of the trench to avoid damage to the pipes through falling stones & debris.

5.10.10 Pipe shall be laid with a cover, measured from the top of the pipe to the surface of the ground of not less than1.2 mtr. under roads

5.10.11 The pipe bedding shall be with a granular material & backfilling shall be performed in layer of 6 inch with each layer & shall be sufficiently compacted to 85% to 95% compaction.

5.10.12 A meachanical compaction shall be carried out for compacting sand & gravel backfill. Optionally manual compaction shall be carried out.

5.10.13 A trench shall be compeltely filled & backfilling shall be palced & spread in uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, etc. shall be removed. Heavy tampers or rolling equipment shall be used for final backfilling only.

5.11 PIPE HANDLING & STORAGE :

5.11.1 The pipe shall not be pushed or dragged from the truck bed. Pallets for pipe shall be removed with a fork lift. Loose pipe can be rolled down on timber.

5.11.2 The pipe shall be stored in open ground which shall be dry & free from sharp objects.

5.11.3 The pipe shall be protected from the sun & shall be in area with proper ventilation.

5.11.4 If the pipe shall be stored in racks or it shall be supported throughtout its length with the spacing not more than 3 feet.

5.12 LAYING & JOINTING :

5.12.1 Pipe shall be cut sqaure with the special tool.

5.12.2 The inside & outside edges shall be cleaned form any burrs with file or deburring tool.

5.12.3 The surface shall be cleaned with a clean dry cloth.

5.12.4 With light pressure, pipe should go one third to one half of the way into the fitting socket.

5.12.5 Pipes & fittings that are too tight shall not be used. Use an applicator having size equal to one half the pipe diameter.

5.12.6 For jointing, full even layer of cement shall be povided on external surface of the pipe & medium layer of cement shall be provided to the inside of a fitting

5.12.7 Pipe & fittings shall be assembled & pipe shall give a qaurter turn.

5.12.8 The piping (for sch. 40) shall be supported by the means of hangers having recommended spacing as below :

NOMINAL PIPE SIZE (MM)	**TEMPERATURE IN DEG. C**				
	15.5	26.6	37.7	48.8	60
15	4.5 MT	4.5 MT	4 MTR.	2.5 MT	2.5 MT

	R.	R.		R.	R.
20	5 MTR.	4.5 MTR.	4 MTR.	2.5 MTR.	2.5 MTR.
25	5.5 MTR.	5 MTR.	4.5 MTR.	3 MTR.	2.5 MTR.
32	5.5 MTR.	5.5 MTR.	5 MTR.	3 MTR.	3 MTR.
40	6 MTR.	5.5 MTR.	5 MTR.	3.5 MTR.	3 MTR.
50	6 MTR.	5.5 MTR.	5 MTR.	3.5 MTR.	3 MTR.
63	6.5 MTR.	6 MTR.	5.5 MTR.	4 MTR.	3 MTR.
75	7 MTR.	7 MTR.	6 MTR.	4 MTR.	3.5 MTR.
100	7.5 MTR.	7 MTR.	6.5 MTR.	4.5 MTR.	4 MTR.
150	8.5 MTR.	8 MTR.	7.5 MTR.	5 MTR.	4.5 MTR.

5.12.9 The pipe joint setting & curing time shall be recommended as :

5.12.10 SET TIME :

Temperature	Pipe size	Pipe Size	Pipe Size

Range	15 mm to 32 mm	40 mm to 75 mm	100 & 150 mm
15.5-37.7 deg C	15 minute	30 minute	60 minute
4.4-15.5 deg C	60 minute	120 minute	240 minute

5.12.11 CURE TIME :

Temperature	Pipe size	Pipe Size	Pipe Size
Range	15 mm to 32 mm	40 mm to 75 mm	100 & 150 mm
15.5-37.7 deg C	6 hrs.	12 hrs.	24 hrs.
4.4-15.5 deg C	12 hrs.	24 hrs.	48 hrs.

5.12.12 To compensate the expansion & contraction, suitable means shall be provided by expansion loops with 90 deg elbows / bellows subject to the application for the above ground installation

5.12.13 For underground application, the compensation for expansion & contraction shall be done by anaking the pipe in trench.

5.13 TESTING :

5.13.1 The pipe shall be tested with water. Before testing, it shall be properly anchored.

5.13.2 Thrust blocks shall be provided at dead ends, at change in direction & at cahnge in size.

5.13.3 The piping shall be slowly filled with water with velocity not exceeding 1ft./sec.

5.13.4 Vents shall be provided at high points & air shall be release before testing.

5.13.5 All valves & vents shall kept open during testing to release the air.

5.13.6 The piping shall be tested for 125% of design working pressure for one hour maximum

5.13.7 During testing, if any joint is leaking, it shall be cut & replaced.

6.0 INTERNAL DRAINAGE (SOIL, WASTE, VENT AND RAIN WATER PIPES):

6.1 SCOPE:

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

6.1.2 Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-

i. Cast Iron / UPVC vertical and horizontal soil waste and vent pipes, rainwater pipes and fittings, joints clamps and connections to fixtures.

ii. Floor traps, floor drain clean out plugs, inlet fittings and rainwater roof drain, area/local drains, trench drain...

iii. Waste pipes connections from all fixtures e.g. wash basins, sinks, kitchen equipment.

iv. Testing of all pipes.

v. Connection of main.

6.2 GENERAL REQUIREMENTS

6.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Client's Representative.

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

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

6.2.4 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.

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

6.2.6 All works shall be executed as directed by Client's Representative.

6.3 CAST IRON PIPES & FITTINGS

6.3.1 Soil, waste, vent and anti-siphonage pipes shall be cast iron pipes with socket and spigot. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast I.S. 1729-1967.

6.3.2 STANDARD WEIGHT DIMENSIONS AND PIG LEAD REQUIRED FOR JOINTS SHALL BE AS FOLLOWS:-

For conforming to I.S. 1729-1967 (sand cast iron soil pipes and fittings)

Diameter	**Thickness**	**Overall Depth**	**Weight 6'length or 1.83 M**	**Internal diameter of socket**	**Depth of lead**
50	5		11.41	76	25
75	5		16.52	101	25
100	5		21.67	129	25
150	5		31.91	181	32

6.3.3 TOLERANCE

Acceptable tolerance for pipes to I.S. 1729 shall be as follows:-

a) Wall thickness -15%
b) Length ± 20 mm
c) Weight ± 10%

6.3.4 FITTINGS

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

6.3.5 JOINTING:

All soil, waste and vent pipes including fixture connections between traps and soil pipes shall be jointed with refined pig lead conforming to IS: 27-1977 sufficient sken of jute rope shall be caulked to leave a minimum space for the pig lead as given in **6.3.2** to be poured in. After pouring the lead shall be caulked into the joint with caulking tool and hammer. All surplus lead shall be cut and joint left flush with the rim of the socket neatly.

6.3.6 Vent pipes penetration through roof shall be by means of sleeves. The sleeve will be kept 100mm higher the finish roof level and annular space filled with fire proof materials like putty, fire seal etc.

6.3.7 PIPE, HANGERS, SUPPORT, CLAMP, BRACKE ETC.:

All vertical pipes shall be fixed by M.S. Clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Inclined pipes running along ceiling shall be fixed on M.S. adjustable hangers of special design shown on the drawings or as directed. Pipes shall be laid to uniform slope and the hangers adjusted to the proper levels so that the pipes fully rest on them.

M.S. clamps shall be of standard design and fabricated from M.S. flat 40mm x 3mm x 3mm thick. They shall be painted with two coats of black bitumen paint before fixing.

Structural clamps shall be fabricated from M.S. structural members e.g. rods, angles, channels, flats, as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding and paint the clamps with one coat of red oxide. Wooden saddles shall be provided free of cost.

Slotted angle/channel supports on walls shall be provided wherever shown on drawings or as required. Angles/channels shall be fixed to brick walls and bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. Holes required in RCC walls shall be neatly drilled by electric drills and no manual chiseling will be allowed. The spacing of supports horizontally shall not exceed 1.8 M.

Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and for making good with cement concrete 1:2:4 (mix 1 cement :2 coarse sand :4 stone aggregate 20mm nominal size) as directed by the Client's Representative.

6.3.8 TESTING:

All pipe work shall be tested before connecting any appliances and then again after connection of appliances. Pipe shall be tested after installation by one of the test given below as directed by the Client's Representative.

Before use at site, all C.I. soil pipes shall be tested by filling up with water for at least 10 minutes at 3 meter head. After filling, pipes shall be struck with a hammer

and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

Water Test:

Pipes shall be tested after installation by filling up the stack with water. All openings and connections shall be suitable plugged. The total head in the stack shall however not 3 M exceed. The level of water in the stack shall not drop within 8 hours. If there is a drop in level of water the leak shall be detected and rectified and test shall be re-conducted until satisfactory result is achieved.

Smoke Test:

Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlet and outlet connections.

The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Client's Representative.

6.3.9 UPVC PIPES AND FITTINGS (RAIN WATER):

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designated by external diameter and shall conform to IS: 4985-1981.

OUTER DIA. (MM)	**PRESSURE (KG/CM^2)**	**INNER DIA. (MM)**	**WEIGHT/MT (KG.)**
110	4	104.5	1.315
125	4	118.7	1.712
140	4	133.0	2.131
160	4	152.0	2.783
180	4	175.9	3.560
200	2	190.1	4.526
225	4	213.8	5.480

Fittings:

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

Laying and Jointing:

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and `O' rubber ring for vertical line. The type of joint shall be used as per site conditions/direction of the Client's Representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with G.I. adopter for insertion in the R.C.C. slab for a water proof joint complete as directed by Client's Representative.

Supports:

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

Repairs:

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chip out occurs in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

Testing:

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

6.3.10 WASTE PIPE FROM APPLIANCES:

i) Waste pipe from appliances e.g. wash basins, sinks, urinals, chrome plate where seen water coolers shall be of galvanised steel (heavy class) conforming to IS:1239-1979.

ii) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:-

	Vertical	**Horizontal**
G.I. Pipes	300 cms	240 cms
P.V.C. Pipes	180 cms	120 cms

6.3.11 PAINTING

Soil, waste vent and rainwater pipes in exposed location, in shafts and pipe spaces shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two or more coats of synthetic enamel paint to give an even shade.

Paint shall be of approved quality and shade, where directed pipes shall be painted in accordance with approved pipe colour code.

Waste pipes in chase shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint.

C.I. soil and waste pipes below ground and covered in cement concrete shall not be painted.

6.3.12 MEASUREMENTS:

C.I. / UPVC/ G.I. waste/soil, waste, vent and rain water pipes shall be measured over all along the center line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all fittings, holder bat clamps, lead caulked joint for C.I. and cement joints for UPVC and all other items described in the Bill or Quantities. The portion of the pipe within the collar for C.I./UPVC pipe at the joint shall not be included in the length of the pipe work.

6.4. SWR uPVC PIPES AND FITTINGS:

6.4.1 Soil, waste, vent SWR Ring Fit pipes with socket and spigot. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. These pipes conform to Indian Standard IS: 4985 – 2000 and are designed to withstand continuous internal hydraulic pressure of 4 Kgf/cm so as to ensure life-long trouble free working. The pipes are provided with an integral rubber ring type socket at one end while the other end is kept plain, smooth and free from burrs. Rubber ring type socket ends provide easy push – fit type jointing. Simultaneously, allowance for thermal expansion can also be provided during installation. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast I.S. 1729-1967.

6.4.2 FITTINGS:

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

6.4.3 JOINTING:

Rubber Seal Rings for Joints & Access Doors : Manufactured in accordance with IS : 5382 for 75 mm / 90 mm / 110 mm sizes. These are made out of natural rubber with a shore 'A' hardness pf 40 × 5. Provide superior resistance to biological attack. Special design of cross section ensures perfect sealing.

Lubricant: Available in 100 gms, 250 gms & 500 gms packing. Specially formulated for compatibility with rubber seal as well as PVC. Does not support the growth of bacteria or fungi.

6.4.4 PIPE, HANGERS, SUPPORT, CLAMP, BRACKE ETC.:

Supports:
UPVC pipes require supports at close intervals. Recommended support spacing for unplastisized PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its

alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

6.4.5 TESTING:

Before the system is put into use, it should be tested for leakages by air test, hydraulic test or smoke test.

6.5 TRAPS:

6.5.1 NAHANI TRAP OR FLOOR TRAPS:

Nahani traps or floor traps shall be cast iron/ PVC / , deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with water proof compound and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth. The trap shall be installed at lowest point ensure no pending occurs at perimeters of the drain.

6.6 FLOOR TRAP INLET

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, the Contractor shall provide a special type galvanised iron inlet fitting without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and fitting shall be connected to a C.I. 'P' or 'S' trap with at least 50mm seal (Hopper and traps shall be paid for separately). Floor trap inlet fittings and the trap shall be set in cement concrete blocks.

6.7 C.P./STAINLESS STEEL GRATINGS

Floor and Urinal traps shall be provided with 100-150mm square or round C.P./Stainless steel grating as approved by Client's Representative with rim, of approved design and shape. Minimum thickness shall be 4-5mm or as specified in the Bill of Quantities.

6.8 CLEANOUT PLUGS

Contractor shall provide cast brass cleanout plugs in all horizontal run more than 15 meter length required one cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

6.9 PIPE SLEEVES

Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes pass through walls and slabs and annular space filled with fire proof materials like putty, fire seal etc. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matters. Vertical sleeve shall finish 50mm above finish floor level.

7.0 EXTERNAL DRAINAGE SYSTEM (SEWERAGE AND STORM WATER):

7.1 SCOPE:

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

ii. Without restricting to the generality of the foregoing, the drainage system shall include:
Sewer lines including excavations, pipe lines, man holes, drop connections, underground storm water drains, including pipes, man holes, catch basins and open drains, thrust blocks.

7.2 GENERAL REQUIREMENTS:

All materials shall be new of the best quality conforming to specifications and subject to the approval of the Client's Representatives.

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

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

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority and also existing invert levels required to enter sanitary system.

Location of all manholes, catch basins, etc. shall be confirmed by the Client's Representatives before the actual execution of work at site.

All excavation, trenches etc shall be barricaded as per instruction of the Client's Representatives.

All works shall be executed as directed by the Client's Representatives.

7.3 TRENCHES FOR PIPE & DRAINS:

7.3.1 ALIGNMENT AND GRADE:

The drains are to be laid to alignment and gradients in continuous shown on the drawings but subject to such modifications, as shall be ordered by the Client's Representative from time to time to meet the requirements of the works. No deviations from the line, depths of cutting or gradients of sewers shown in the plans and sections shall be permitted except by the express direction in writing of the Client's Representative.

7.3.2 OPENING OUT TRENCHES:

In excavating the trenches at the road metaling, pavement kerbing etc. are to be placed on one side and preserved for rein statement when the trench or other excavation shall be filled-up.

Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Client's Representative. The Contractor shall not cut or break down any live fence or trees in the line of the proposed works but shall tunnel under them unless the Client's Representative shall order to the contrary.

Trench to be excavated to alignment + depth required. Trench to be properly

dressed and de-watered. Trench shall be kept free of water at all time. Discharge of water shall be into nearest drainage channel not on the road.

All under ground pipe to be laid open in trench. Pipes to be laid and maintained at required levels and grade during course of work. All joints to be aligned and complete.

Trench shall be of 450mm wide than pipe. Concrete anchors at change in direction for C.I. pipe shall be provided. Pipe shall be rest on cushion in the trench.

The Contractor shall scrub up and clear the surface over the trenches and other excavations of all stumps, roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Client's Representative.

7.3.3 CONSTRUCTION ACROSS THE ROADS:

All the pipe line or drain crossing existing road, the road crossing shall be excavated at a time, the second half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measure for traffic as directed shall be adopted. All type of pipes, water mains, cables etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable removal of which is necessary shall be arranged by the Client's Representative or the Contractor shall arrange to support and protect them during excavation.

7.3.4 EXCAVATION TO BE TAKEN TO PROPER DEPTH:

The trenches shall be excavated to such depth and width that the sewers pipe shall rest on cushion so that the inverts may be at the levels given on the section/plan. In bad ground the Client's Representative may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewer with such materials as decided by Client's Representative in writing.

7.3.5 REFILLING:

The filling shall be done in layers not exceeding 15mm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of the crow brass where rammers can not be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.
Filling in trenches shall be commenced soon after the joints of pipes, cables; conduits etc. have been tested and approved by Client's Representative. The space around the pipes shall be cleared of all debris where the trenches are excavated in hard/soft soil. The filling shall be done with earth on the sides and tops of pipes in layers not exceeding 15mm in depth. Each layer shall be watered rammed and consolidated. The clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the excavated earth is used for filling. Generally no test is done to determine the instrument diversity of filled earth but on the discretion of Client's Representative the 95 proctor's compaction test may be done to ensure the in situ density after filling. Consolidation is removal of water from the pores and compaction is the explosion of air from the pores. In case of refilling consolidation places most important role as the watering of the each layer is being done properly. If required by the Client's Representative proctors needle may also be used for the proper checking of the refilling items of in situ density.

7.3.6 CONTRACTOR SHALL RESTORE SETTLEMENT AND DAMAGES:

The Contractor shall at his own cost make good promptly during the whole period the works are in hand, any settlements that may occur in the surfaces or roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations due to not using the method of compaction as given in clause 7.3.5 and he shall be liable for any accidents caused thereby.

He shall also at his own expense and charges, repair and make good any damage done to the building and other properties.

7.3.7 DISPOSAL OF SURPLUS SOIL:

The Contractor shall at his own cost and charge, dispose off from the site all surpluses excavated material not required to be used on the works.

i. The width of excavated trench shall be as per table given below:

Excavation upto Upto 150 mm	**Upto 100 mm**	
	Dia. Pipe	**Dia. pipe**
90 cms depth cms	33 cms	33
90 - 150 cms depth 60 cms	60 cms	
150 - 300 cms depth cms	75 cms	75
300 - 500 cms depth cms	90 cms	100

7.3.8 PROTECTION OF EXISTING SERVICES:

All pipes, water mains, cables etc encountered in the course of excavation shall be carefully protected and supported. In case of any damage caused the same shall be made good at no extra cost failing which necessary works will be carried out by the Clients Representative and contract charged to the Contractor.

7.4 RCC PIPES:

7.4.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes NP2 for general and NP3 where road crossing. Pipes shall be true and straight with uniform bore throughout. Cracked, wrapped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, prior to use on site, a certificate to that effect from the manufacturer.

The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to IS: 458 - 1971. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process.

All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. The pipes shall be R.C.C. light duty, NP2 and NP3 type.

7.4.2 LAYING:

R.C.C. spun pipes shall be laid on cements concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be pre-cast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and boning rods, etc. Cradles or concrete bed may be omitted, if directed by the Client's Representatives.

7.4.3 JOINTING (RIGID SPIGOT AND SOCKET JOINT):

Hemp rope soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added and rammed home. Cement mortar with one part of cement and one part of sand and with minimum water content but on no account soft or sloppy, shall be carefully inserted, punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degree.

7.4.4 CURING:

The joint shall be cured for at least seven days.

7.4.5 CEMENT CONCRETE FOR PIPE SUPPORTS:

a) Unless otherwise directed by the Client's Representative cement concrete for bed, all round or in haunches shall be laid as follows:

	Upto 1.5m depth (5')	**Upto 3m depth (10')**	**Beyond 3m depth (10')**
Pipes in open ground (no sub soil water)	all round (1:5:10)	in haunches (1:3:6)	all round (1:5:10)
RCC/C.I. pipes in sub soil water	all round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
RCC/C.I. pipes (in all conditions)	all round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
RCC/C.I pipes under road or building	all round (1:3:6)	all round (1:3:6)	all round (1:3:6)

b) RCC pipes or CI pipes may be supported on brick masonry or pre-cast RCC or in situ cradles. Cradles shall be as shown on the drawings.

c) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7.4.6 TESTING:

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

Permissible drops in water head should not exceed ……..

7.4.7 MEASUREMENT:

a) Excavation:
Measurement for excavation of pipes trenches shall be made per linear meter.

b) Trenches shall be measurement between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth upto 1.5 meter or as given in the Bill of Quantities.

Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the Bill of Quantities and above the rate for depth upto 1.5 m.

c) RCC pipes shall be measured for the length of the pipe line per linear meter i.e.:

i. Length between manholes shall be recorded from inside of one manhole to inside of other manhole.

ii. Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole.

7.5 STONEWARE PIPE

a) GENERAL REQUIREMENTS

7.5.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Consultant/ Client/ Architect.

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

7.5.2 All drainage work shall be done in accordance with the local Municipal by-laws.

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

7.5.4 Location of all manholes, catch basins etc. shall be got confirmed by the Consultant/ Client/ Architect before the actual execution of work at site.

7.5.5 All works shall be executed as directed by Consultant/ Client/ Architect.

a) ALIGNMENT AND GRADE

The sewer and storm water drainage pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Consultant/ Client/ Architect from time to time to meet the requirements of the works. No deviation from the lines, depth of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Consultant/ Client/ Architect.

b) EXCAVATION

The excavation for sewer works shall be open cutting unless the permission of the Consultant/ Client/ Architect for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Consultant/ Client/ Architect may order the excavation to be made party in

tunnel and in such cases the excavated soil shall be brought back later on for refilling the trenches or tunnel.

c) OBSTRUCTION OF ROADS

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall be then left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Architect in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

d) EXCAVATION TO BE TAKEN TO PROPER DEPTH

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating there to and so that the inverts may be at the levels given in the sections. In bad ground, the Consultant/ Client/ Architect may order the contractor to excavate to a greater depth than that shown on the drawings and to fill up excavation to the level of the sewers with the concrete, broken stone, gravel or other materials, the contractor, shall be paid extra at rates laid down for such works in the schedule. If the extra work was ordered by the Consultant/ Client/ Architect in writing, but if the contractor shall excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Consultant/ Client/ Architect the extra depth shall have to be filled up with concrete at the contractor's own cost and charges to the requirements and satisfaction of the Consultant/ Client/ Architect.

e) REFILLING

After the sewer or other works has been laid and proved to be water tight, the trench or other excavation shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms. Above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms. Layers and consolidated. After this has been laid, the trench and other excavation shall be refilled in 15 cms. Layers with materials taken from the excavation, each layer being watered to assist in the consolidation, unless the Architect shall otherwise direct.

f) CONTRACTOR TO RESTORE SETTLEMENT AND DAMAGES

The contractor shall as his own costs and charges, make good promptly during the whole period for the works in hand, any settlement that may occur in the surfaces of roads beams, footpaths, gardens, open spaces etc. whether public or private caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair and make good may damage done to building and other property. If in the opinion of the Consultant/ Client/ Architect he fails to make good such works with all practicable dispatch, the Consultant/ Client/ Architect shall be at the liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him any other manner according to the law of land.

g) DISPOSAL OF SURPLUS SOIL

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

h) TIMBERING OF SEWER AND TRENCHES

1. The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, pilling and sheeting and they shall be closed, timbered in loose or sand strata and below the surface of the sub soil water level.

2. All timbering, sheeting and piling with their walling and supports shall be of adequate dimension and strength and fully braced and strutted so that no risk of collapse of subsidence of the walls of the trench shall take place.
3. The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, sheeting and pilling used as also for all damage to persons and property resulting from improper quality, strength, maintaining or removing of the same.

i) SHORING OF BUILDINGS

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

j) REMOVAL OF WATER FROM SEWER, TRENCH ETC.

1. The contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private properly nor the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

2. If any excavation is carried out at any point or points to a greater width the specified cross section of the sewer with its envelop, the full width of the trench shall be filled with concrete by the contractor at his own expense and charges to the requirements of the Consultant/ Client/ Architect.

k) WIDTH OF TRENCH

The Consultant/ Client/ Architect shall have power by giving an order in writing to the contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classed of sewer, manholes and other works in certain lengths to be specifically laid down by him where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.

Recommended width of trenches at the bottom of the trench are as follows:

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

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

m) SALT GLAZED STONEWARE PIPES:

Stone ware pipe shall be of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufacturers names marked on it and shall comply to IS 651-1971.

n) LAYING AND JOINTING OF STONEWARE SALT GLAZED PIPES :

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

2. The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

3. Where pipes are not bedded in concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest no firm ground. If excavation has been carried too low it shall be made up with cement concrete at the contractor's cost and charges.

4. If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed to ensure even bearing.

o) JOINTING OF PIPES

1. Tarred gasket shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then adjusted and fixed in its correct positions and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

2. The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement : 1 clear sharp washed sand). When the socket is filled, a filled should be formed round the joint with a trowel forming an angle of 45 Degrees with the barrel of the pipe. The mortar shall be mixed as needed For immediate use and no mortar shall be beaten up and used after it has begun to set.

3. After the joint has been made, any extraneous material shall be removed from inside of the joint with a suitable scraper or 'badgar'. The newly made joint shall be protected until set from the sun, drying winds, rains or dust. Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Consultant/ Client/ Architect. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

p) TESTING

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

2. Sewer lines shall be tested for a straightness by :

(i) Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstruction such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end.

(ii) Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.

(iii) The contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the Consultant/ Client/ Architect.

(iv) A test register shall be maintained which shall be signed and dated by contractor. Architect and representative of consultants.

q) MASONRY WORK

Masonry work for manhole, chambers, septic tanks and such other works as required shall be constructed from local best quality bricks in cement mortar 1 : 5 mix (1 cement : 5 coarse sand) or as specified in the Bill of Quantities. All joints shall be properly raked to receive plaster.

r) CEMENT CONCRETE FOR PIPE SUPPORT

1. Wherever specified or shown on the drawings, all pipes shall be supported in bed all round or in haunches. The thickness and mix of concrete shall be as given in the Bill of Quantities. Widths of the bedding shall be as per Para 13.

2. Unless otherwise directed by the Consultant/ Client/ Architect, cement concrete of bed, all rounds or in haunches shall be laid as follows:

	Upto 1.5 m depth	Upto 3 m depth	Beyond 3 m depth
RCC, stoneware pipes in open ground (above sub soil water)	All round (1 : 5 : 10)	In haunches (1 : 5 : 10)	In haunches (1 : 5 : 10)
C.I.pipes in sub soil water	All round (1 : 3 : 6)	In haunches (1 : 3 : 6)	In haunches (1 : 3 : 6)
RCC or S.W. pipes in sub soil water	All round (1 : 3 : 6)	All round (1 : 3 : 6)	All round (1 : 3 : 6)
RCC or S.W. pipes under floors or building	All round (1 : 2 : 4)	All round (1 : 2 : 4)	All round 3. : 2 : 4)

3. RCC pipes or C.I. or stoneware pipes may be supported on brick masonry or precast RCC or in situ cradles. Cradles shall be as shown on the drawing.

4. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

5. Hand mixing on properly constructed platforms may be allowed for small quantities by the Consultant/ Client/ Architect. Rate for cement concrete shall be inclusive of all shuttering and centering at all depths and heights.

6. Concrete work shall be of such thickness and mix as given in the Bill of quantities.

7. All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during curing period.

7.6 SEWER MANHOLES WITH FRAME AND COVER:

7.6.1 SCOPE

This specification covers the requirements for providing and constructing of Brick Masonry (for up to 3 mtr. depth) / RCC M 20 grade or 1:1x1/2 :3 mix (for more than 3 mtr. depth) manholes with steps, frame, cover and vent shafts.

7.6.2 STANDARDS

The following standards/codes, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards /codes shall be referred to.

IS : 210	Specification for gray iron castings
IS : 269	Specification for ordinary and low heat Portland cement
IS : 383	Specification for coarse and fine aggregates from natural sources for concrete
IS : 432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
IS : 516	Methods of tests for strength of concrete
IS : 651	Specification for salt-glazed stoneware pipes and fittings
IS : 1077	Specification for common burnt clay building bricks
IS : 1726	Specification for cast iron manhole covers and frames
IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS : 2116	Specification for sand for masonry mortars
IS : 3495	Methods of tests of burnt clay building bricks
IS : 5455	Specification for cast iron steps for manholes

7.6.3 CODES OF PRACTICE

IS : 456	Code of practice for plain and reinforced concrete
IS : 2212	Code of practice for brickwork
IS : 2250	Code of practice for preparation and use of masonry mortars
IS : 4111	Code of practice for ancillary structures in sewerage system part 1manholes
IS : 4127	Code of practice for laying of glazed stoneware pipes

7.6.4 LOCATION

Manholes shall be constructed in accordance with the drawings at the locations indicated thereon.

7.6.5 CONSTRUCTION MANHOLES:

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be according to NBC.

Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer-in- charge. The size specified shall indicate the inside dimensions between brick faces of the manholes.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber. In exceptional cases and where unavoidable, the crown of the branch sewer may be fixed at lower level but in such cases the peak flow level of the two sewers shall be kept the same.

Sewers of unequal sectional area shall not be jointed at the same invert in a manhole. The invert of the smaller sewer at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch sewers shall deliver sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

No drain from house fittings, e.g. gully trap or soil pipe, etc. to manhole shall normally exceed a length of 6 m unless it is unavoidable.

Manholes 90 x 80 cm are generally constructed within compound for house drainage only and near the buildings for house drainage. Manholes 1.2 m x 90 cm are generally constructed for main drainage work for depths less than 1.5 m.

Manhole 1.4 m x 90 cm is of the arched type and is generally constructed for main drainage works where depth is 1.50 m or more. The width of manholes shall be increased more than 90 cm on bends or junctions or pipes with diameter greater than 450 mm and that the benching width on either side of the channel is minimum 20 cm.

Manholes 1.4 m internal diameter are generally constructed for main drainage works where depth is 2.45 m or more as an alternative to manholes of arch type. The diameter shall be increased suitably, for pipes with diameter greater than 450 mm in the same manner as in the case of rectangular manholes.

Before deciding size of manholes, it shall be as specified in BOQ or as per Local Municipal Bye Laws. When manholes are constructed on foot path, these shall be provided with cover of medium duty casting and when built within the width of the road under vehicular traffic, these shall be provided with cover of heavy duty casting.

7.6.6. EXCAVATION

The excavation for manhole shall be true to dimensions and levels shown on the plans or as directed by the Engineer-in-charge.

7.6.7 BED CONCRETE

The manhole shall be built on a bed of foundation PCC 1 : 2 : 4 unless required by local authorities. The thickness of the bed concrete shall be 15 cm for manholes up to 4.5 m depth and 30 cm for depths beyond 4.5 m unless otherwise specified or directed by the Engineer-in-charge. In bad ground, special foundations as suitable shall be provided.

7.6.8. BRICK MASONRY / CEMENT CONCRETE WORK

BRICK MASONRY

For depth up to 3 mtr, manhole shall be constructed with masonry wall, for more than 3 mtr. Depth, it shall be of M 20 grade as specified below:

The brick work shall be with class 75 bricks in cement mortar 1:4 (1 cement: 4 coarse sand).
The brick work shall be with class 75 bricks in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof. For arched type and circular manholes, brick masonry in arches and arching over the pipes shall be in cement mortar 1 : 3 (1 cement: 3 fine sand). In the case of manholes of circular type the excess shaft shall be corbelled inwardly on three sides at the top to reduce its size to the cover frame to be fitted.

The walls shall be built of one brick thickness for depths up to 4.25 m. below a depth of 4.25 mtr in ordinary subsoil the wall thickness shall be increased to one and half brick and at 9.75 m below ground two brick thick walls

CEMENT CONCRETE WORK

The walls shall be built of M20 grade (1 cement : 1.5 coarse sand : 3 coarse aggregate having 20 mm nominal size) with 15 cm thickness for depth up to 4.5 m. Below a depth of 4.5 m in ordinary subsoil the wall thickness shall be increased to 30 cm

The thickness of the wall shall be take the total load coming over it including earth pressure & water pressure. The chamber shall be tested for water tightness.

The wall shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

For earth work excavation, bed concrete work, R.C.C. work and refilling of earth, respective specifications shall be followed.

PLASTER AND POINTING

In case of brick walls, the walls of the manholes shall be plastered inside with 20 mm thick cement plaster 1:2 (1 cement: 2 coarse sand) finished smooth. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

For earth work excavation, bed concrete brick work, plaster and pointing, R.C.C. work and refilling of earth, respective specifications shall be followed.

7.6.9 BENCHING

The channels and benching shall e done in cement concrete 1:1.5:3 (1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size) and rendered smooth with neat cement. The depth of channels and benching shall be as given in Table .

SIZE OF DRAIN WALLS ABOVE	TOP OF CHANNEL AT THE CENTER ABOVE BED CONC.	DEPTH OF BENCHING AT SIDE BED CONC.
10 cm	15 cm	20 cm
15 cm	20 cm	30 cm
20 cm	25 cm	35 cm
25 cm	30 cm	40 cm
30 cm	35 cm	45 cm

7.6.10 FOOT RESTS

All manholes deeper than 0.8 m shall be provided with foot rests.

7.6.10.1 Foot rest shall be CI type, each weighing 5.5 Kg, 1:2:4 coping.

7.6.10.2 Alternatively MS foot rest shall be provided. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:2:4 (1 cement : 4 coarse sand : 4 graded stone aggregate 20 mm nominal size). The concrete block with M.S. foot rest placed in its center shall be cast in situ along with the RCC wall & finished smooth.

SIZE OF DRAIN MM	TOP OF CHANNEL AT THE CENTER ABOVE BED CONCRETE CM	DEPTH OF BENCHING AT SIDE WALLS ABOVE BED CONCRETE CM
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

Foot rests which shall be of 20x20 Sq. M.S. bars.
Foot rests shall be fixed 40 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing.

7.6.11 MANHOLE COVERS AND FRAMES

The frame of manhole shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, manhole covers shall be sealed by means of thick grease.

7.6.12 MEASUREMENTS

Manholes shall be enumerated under relevant items. The depth of the manhole shall be reckoned from the top level of RCC cover to the invert level of channel. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

7.6.13 RATE

The rate shall include the cost of materials and labour involved in all the operations described above but exclude the cost of (i) excavation, (ii) refilling (iii) dewatering if required. These items shall be paid for separately under relevant items of work.

Payment for extra depths of manholes shall be made separately under relevant items of work.

7.7 DROP CONNECTION

In cases where branch pipe sewer enters the manhole of main pipe sewer at a higher level than the main sewer, a drop connection shall be provided. The work shall be carried out as per specifications and RCC pipes and special conforming to IS: 458 shall be of the same size as that of the branch pipe sewer.

For 150 and 250 mm main line, if the difference in level between the water line (peak flow level) and the invert level of the branch line is less than 60 cm, a drop connection may be provided within the manhole by giving suitable ramp. If the difference in level is more than 60 cm, the drop shall be provided externally.

The sewer main lines shall be designed with 0.8 full flow.

7.7.1 EXCAVATION

The excavation shall be done for the drop connection at the place where the branch line meets the manhole the excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line.

7.7.2 MEASUREMENTS

Drop connection shall be enumerated. The depths beyond 60 cm shall be measured in running metres correct to a cm under relevant items.

7.7.3 RATE

The rate shall include the cost of labour and materials involved in all the

operations described above but excluding the cost of excavations and refilling.

7.7.4 TESTING

The interior of manholes shall be cleared of all debris after construction and before testing the same for water tightness by Contractor.

Water for testing of manholes along with pipeline shall be arranged by Contractor at his own cost.

7.7.5 R.C.C PRE CAST M.H.F.C.

Manufacture, supply delivery at site of work and fixing on top of manhole precast RCC Frame & cover suitable to drainage M.H. and including cost of reinforcement M.S. Angles or Flat, curing, mold work etc.

7.7.6 GENERAL SPECIFICATION

R.C.C Precast manhole frame & cover shall be manufacture as per standard type design. Frame shall confirm to IS: 12592 part – II – 1991. Cover shall confirm to IS : 12592 part – I – 1988.

7.7.7 MATERIAL

Sand, cement, water, aggregates and reinforcement steel shall confirm to relevant I.S. specifications. Thickness of frame shall be 10 cm. Necessary reinforcement, M.S. angle or flat shall be placed as per design during the concreting work fabrication of R.C.C. M.H.F.C shall be carried out by mechanically vibrating process.

7.7.8 INSPECTION :

Inspection of materials will be carried out at work site by the Engineer who shall carry out inspection as soon as material is brought on work site. Inspection will be carried out normally within one week time. The supplier has to take care of the following points.

The manufacturer has to go in for one line stenciling for identifying size and class for proper separation.

The unloaded material has to be stacked in manageable batches with adequate inspection space like spreading the pieces etc. to permit proper inspection.

7.7.9 TRANSIT RISK

The contractor shall bring goods at his own risk or it should be covered against the transit risk at its own cost.

7.7.10 TEST CERTIFICATE

The contractor shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

The supplier shall also produce in addition to manufacturer's test certificate as mentioned in above, the inspection certificate issued by Engineer for the same purpose.

7.7.11 FIXING

Precast R.C.C. frame shall be fixed on the top of manhole and properly embedded in cement concrete 1:1.5:3 in required quantity in such a way that the top of the cover when placed in position shall remain at the finished road level.

7.7.12 MEASUREMENT

The measurement shall be made on number basis subsequent to fixing the frame on top of manhole and placing the cover in the frame.

7.7.13 MARKING

Each manhole frame and cover shall have cast on them the following information.

a) Manufacturer's name or trademark.
b) Grade denoted by abbreviation such as HD, MD or LD.
c) The word SWD or sewer to denote storm water drain or sewer respecting if desired.
d) An identification name as required by purchaser.