



**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

**Renovation of Existing Toilet block at 4<sup>th</sup>, 5<sup>th</sup>, &  
6<sup>th</sup> Floor of Reclamation Building, East Yard,  
MDL, Dockyard Road, Mumbai.**

**VOLUME-IV**

**PREFERRED MAKE  
&  
TECHNICAL SPECIFICATIONS**

**TECHNICAL SPECIFICATIONS FOR CIVIL WORKS****Contents**

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**TECHNICAL SPECIFICATIONS FOR CIVIL WORKS**

1. Following are the list of preferred makes to be used in execution of works, if the same are not specified.

**LIST OF PREFERRED MAKE:**

<b>S.N.</b>	<b>DESCRIPTION MATERIAL</b>	<b>OF</b>	<b>MAKE OF MATERIALS</b>
1.	Plywood		Anchor / Archid / Century / Kenwood / Garnet / Samrat / Green / Prince / Mayur (6mm, 9mm, 12mm, 19mm or any other thickness.
2.	Laminates		Formica / Greenlam / Century / Signature / Heritage / Archid / Bravia Newmica / Kitmica
3.	Screws		GKW / Mettle fold
4.	Brass hinges		Magnum, Reliance, Punit heavy duty.
5.	Hardware		Shalimar, Everite, Reliance(brass powder coated)
6.	Door lock / handles		4-C ACME, Golden, Godrej, Ultra.
7.	Veneer		Anchor / URO / Durian / Century.
8.	Adhesives		Fevicol (SH), Mowicoll, Mahacol, Araldite
9.	Wood preservatives		Woodguard, PCI, Black Japan.
10.	Door closure		Efficient gazets, Everite Hyper.
11.	Glass		Modi / Saint Gobain / Hindustan Palington / Asahi / Triveni
12.	Paint		Burger, Nerolac, Asian, Dulux, Tractor.
13.	Vitrified/ Ceramic/Glazed Tiles		Nitco, Kajaria, RAK, Bells, Johnson /Regency/Bells
14.	Aluminium sections		Jindal / Indal
15.	Wood preservative		Asian paint / Pidilite / MRF
16.	Cement		Ultratech/ ACC / Ambuja / Birla
17.	Putty		Birla White Putty
18.	Stainless steel sink		Nirali / Diamond
19.	Water proofing material / compound.		Sika / Roff / Sunanda / Krishna Conchem
20.	Panelled Doors		National / Century / Swastik / Kitply
21.	P.V.C. Doors		Sintex
22.	Vitreous sanitary ware (if not specified in BOQ)		Jaquar/Hindustan sanitary ware/parry ware/ Bells/Cera
23.	Seats & Covers solid (W.C.)		Jaquar/Hindustan sanitary ware/parry ware/ Bells / Cera
24.	PVC flushing cisterns		Jaquar / Parryware / Hindustan /Sanitary Wall
25.	C P Fittings / Toilet Accessories		Jaquar
26.	G.I. Pipes ( B-Class)		Tata / Zenith
27.	G.I. Fittings (ISI Brand)		Unik / AMCO
28.	Ball valves		Zoloto
29.	Sanitary Fixture		Jaquar/Hindware / Parryware / Cera.

<b>S.N.</b>	<b>DESCRIPTION MATERIAL</b>	<b>OF</b>	<b>MAKE OF MATERIALS</b>
30.	PVC Fittings (Moulded)		Finolex / Prince

**Notes:**

- i. Wherever specification of BOQ item is not mentioned; then CPWD specification shall be applicable.**
- ii. Wherever make is specified in BOQ then manufacture's specifications & procedure shall be applicable.**
- iii. Wherever no specifications or make is specified than work is to be carried out as per the written direction of Engineer-In-Charge**

## **2. GENERAL**

### **2.1. Materials**

All materials required to complete the works shall be procured by the contractor including steel and cement unless specified. All materials shall be of Indian origin of the best quality of their respective kinds as specified and shall conform strictly to the stipulations laid down by the latest Indian Standards. Standards issued elsewhere may be used only if approved by the Engineer-In-Charge and for those materials only for which appropriate Indian Standard does not exist.

### **2.2. Sampling and Testing**

The Contractor shall submit adequate number of samples of materials to the Engineer-In-Charge for approval giving all relevant information like source of supply, availability, etc. The approved samples shall be deposited with the Engineer-In-Charge whenever so instructed.

The Engineer-In-Charge shall order such tests and analysis of all materials before leaving the manufacturer's premises or the source of supply and/or when brought on site as considers necessary and the Contractor shall bear the cost of all sampling and testing which is in consonance with the Indian Standards.

If tests on materials lead to rejection of the particular consignment, notwithstanding the results of the tests at the manufacturer's works or elsewhere or of test certificates or of any approval given earlier, such materials shall be removed forthwith from the site by him at his own cost and replaced by other proper consignment. All charges in connection with of the new materials shall be borne by the Contractor.

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

### **2.3. Storage of Materials**

Generally stacking and storage of construction materials at site shall be as per recommendations in IS: 4082. All materials required to be incorporated in the Works shall be stored in racks in bins, under cover etc. as appropriate and as amplified in the succeeding clauses to prevent deterioration or damage from any cause whatsoever to the satisfaction of the Engineer-In-Charge.

### **2.4. Records & Usage of Materials**

The Contractor shall maintain detailed records of all materials received at Site or in his workshop and also about the consumption, balance in stock etc. and shall make such records available to the Engineer-In-Charge at all times as the latter may reasonably require.

Depending on the types of materials the same should be used in the order in which they arrive at site and as directed by the Engineer-In-Charge.

**2.5. Contractor's Responsibility**

The Contractor shall be responsible for keeping the material in sound and acceptable condition from the time of consignment of any material is received at site and till its consumptions. Any material not approved for use shall be removed from the site at Contractor's cost.

**2.6. Workmanship**

In all cases the work shall be carried out in accordance with the latest Indian Standard Specifications and the best Engineering practice. In the absence of such specifications, work shall be executed in accordance with any other relevant standards issued elsewhere as approved by the Engineer-In-Charge or as per the instructions and directions of the Engineer-In-Charge.

**2.7. Constructional Plant (s)**

The Contractor shall be responsible for the supply, use and maintenance of all Constructional Plant and Equipment so as to ensure smooth and efficient working of the job at his own cost. The Engineer-In-Charge shall have access to the Plant at all times.

**2.8. Workmen and Staff**

The Contractor shall ensure that they employs only capable and experienced labour force, foremen, other tradesmen and supervisory staff on the job capable of handling the types of work assigned to them in a workmanlike and efficient manner to the satisfaction of the Engineer-In-Charge. They shall also ensure that his Sub-contractors or nominated Sub-contractors also employ all workmen and supervisory staff capable of delivering work of a high standard.

For all concrete work, a fully qualified and experienced Quality Control Engineer shall be employed by the Contractor and he shall be available on Site at all times when concreting operations are in progress. Operators for mixers, mechanical vibrators and personnel in-charge of placing of concrete shall be fully trained and experienced for their type of work.

**2.9. Method of Measurement**

Mode of measurement shall be in accordance with the relevant parts of IS: 1200 "Method of Measurement of Building and Civil Works" only, unless otherwise specified in various item wise specifications describes herein below.

**2.10. Rates and Prices**

Unless otherwise mentioned, the rates and prices set against items in the bill of quantities or which can be reasonably inferred there from complete as a functioning entity shall include all costs and expenses which may be required in and for the construction of the work such as- material to be incorporated in the works (permanent/ temporary), labour required for all operations, temporary works, tools and equipments as required, all operations required for the completion and or maintenance of the relevant items as per specifications, all leads and lifts unless

otherwise specifically mentioned in the items, including all general risks, liabilities and obligations set forth or implied in the documents on which the tender is based.

### 2.11. List of Bureau of Indian Standard Codes (BIS)

Following is the consolidated list of various Indian Standards relevant to the civil works appearing in this specification.

#### GENERAL

S. No	IS Code No	Particulars
1	IS : 4082-1977	Carriage of materials. Recommendation of stacking and storage of construction materials at sites. (1 <sup>st</sup> revision) (Reaffirmed-1990)
2	IS:1200 (Part 22)-1988	Method of Measurement of Building & Civil Engineering Works-Part 22-Materials
3	IS : 17293-1974	Safety code for working with construction machinery
4	IS : 7969-1975	Safety code for handling & storage of building materials
5	IS:13416 (Part 1) 1992	Preventive measures against hazards at work places - Part 1 - Falling material hazard prevention.
6	IS : 13416 (Part 2)1982	Preventive measures against hazards at work places recommendations - Fall prevention.
7	IS: 13416 (part 3) 1994	Preventive measures against hazards at work places - Recommendations - Part 3 - Disposal of debris (MULBA)
8	IS : 13416 (Part 5) 1994	Preventive measures against hazards at work places - Recommendations - Part 5 - Fire protection

#### MORTARS

S. No	IS Code No	Particulars
1	650	Specification for standard sand for testing of cement
2	3025	Method of sampling and test for water
3	8112	Specification for 43 grade ordinary Portland cement
4	12269	Specification for 53 grade ordinary Portland cement.

#### BRICK WORK

S. No	IS Code No	Particulars
1	1200 (Part 3) 1976	Method of measurements of building and civil engineering works: Part 3 brick work (3 <sup>rd</sup> revision) Reaffirmed 1992
2	2212-1991	Code of practice for brick work (1 <sup>st</sup> revision)
3	1905-1980	Code of Practice for structural safety of buildings - Masonry wall
4	2116-1980	Specification for sand for masonry mortars (1 <sup>st</sup> revision)

#### MARBLE/GRANITE / STONE WORK

S. No	IS Code No	Particulars
1	3316 - 1974	Granite slabs

**WOOD WORK**

<b>S. No</b>	<b>IS Code No</b>	<b>Particulars</b>
1	287-1973	Recommendations for maximum permissible moisture content of timber used for different purposes (3 <sup>rd</sup> revision)
2	1200 (Part XII)1973	Wood work and joinery (2 <sup>nd</sup> revision) (Amendment 1) (Reaffirmed 1992)
3	2202 (Part I &II) 1991	Specification for wooden flush door shutters (solid core type) plywood face panels (5 <sup>th</sup> revision) (Amendments 2)
4	3087-1985	Specification for wood particle boards (medium density) for general purposes (1 <sup>st</sup> revision) (Amendments 4) (Reaffirmed 1990)
5	4021-1995	Timber door, window and ventilator frames.
6	883	Defects permissible
7	1708 (Part - I)	Moisture Content
8	2095	Gypsum Board

**FLOORING**

<b>S. No</b>	<b>IS Code No</b>	<b>Particulars</b>
1	777-1988	Specification for glazed earthenware wall tiles (2 <sup>nd</sup> revision) (Superseded by IS 13753, 13754, 13755, 13756)
2	1130-1969	Specification for marble (Blocks, slabs and tiles) (Reaffirmed 1993)
3	1200-1977	Method of measurement of building and civil engineering work (Part XI) paving, floor finishes, dado and skirting) (3 <sup>rd</sup> revision) (Amendment 1) (Reaffirmed 1992)
4	2571-1970	Code of practice for laying in situ cement concrete flooring (1 <sup>st</sup> revision) (Reaffirmed 1991)
5	8042-1989	Specification for white Portland cement (2 <sup>nd</sup> revision) (Amendments 4)
6	13755	Ceramic tiles
7	4457 - 1982	Ceramic unglazed vitreous acid resting tiles

**FINISHING**

<b>S. No</b>	<b>IS Code No</b>	<b>Particulars</b>
1	104-1979	Specification for ready mixed paint, brushing, zinc chrome, priming (Reaffirmed 1993) (2 <sup>nd</sup> Revision)
2	109-1968	Ready mixed paint, brushing, priming plaster to Indian Standard colour No.361.631 white and off white (Reaffirmed 1993) (1 <sup>st</sup> Revision)
3	419-1967	Putty for use on window frames (Reaffirmed 1992) (Revised)
4	428-1969	Distemper, oil emulsion, colour as required (Reaffirmed 1993) (1 <sup>st</sup> Revision)
5	1200-1976 (Part XII)	Method of measurements of building and civil engineering works: Part XII – Plastering and pointing (Reaffirmed 1992) (3 <sup>rd</sup> Revision)
6	1200-1994(Part XIII)	Method of measurements of building and civil engineering works: Part XIII – white washing, colour washing, distemping and painting of building surfaces (5 <sup>th</sup> Revision)



7	1200-1987 (Part XV)	Methods of measurements of building and civil engineering works: Part XV – Painting, polishing, varnishing etc. (Reaffirmed 1992) (4 <sup>th</sup> Revision)
8	2932-1994	Enamel, synthetic, exterior (a) undercoating (b) Finishing (2 <sup>nd</sup> Revision)
9	5410-1992	Cement paint (1 <sup>st</sup> Revision)
10	1661	Application of plaster
11	1542	Plaster for sand
12	2645	Integral waterproofing compound
13	2395 (Part I & II)	Painting workmanship

#### **DISMANTLING AND DEMOLITION**

<b>S. No</b>	<b>IS Code No</b>	<b>Particulars</b>
1	1200-1974	Method of measurements of building and civil engineering works: Part XVII: Demolition and dismantling (Reaffirmed 1992) (3 <sup>rd</sup> Revision)

#### **ALUMINIUM WORK**

<b>S. No</b>	<b>IS Code No</b>	<b>Particulars</b>
1	1285-1975	Specification for wrought aluminium and aluminium alloy, extruded round tube and hollow sections (for general engineering purposes)
2	1868-1996	Anodic coatings on aluminium and its alloys – Specification
3	1948-1961	Specification for aluminium doors, windows and ventilators (Reaffirmed 2001)

#### **WATER PROOFING**

<b>S. No</b>	<b>IS Code No</b>	<b>Particulars</b>
1	2645-1975	Specification for integral cement water proofing compounds.
2	1077	Brick bats

### **3. EARTH WORKS**

#### **3.1. Earthwork in Excavation & Backfilling**

##### General

Any excavation shall be started only after recording the existing ground levels jointly with the Engineer-In-Charge.

##### Classifications

All materials to be excavated shall be classified by Engineer-In-Charge, into one of the following classes and shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist or wet. The decision of Engineer-In-Charge regarding the classification of the materials shall be final and binding on Contractor.

Earthwork will be classified under any of the following categories –

##### **(a) Ordinary & Hard Soils**

These shall include all kinds of soils containing kankar, sand, silt, moorum and / or shingle, gravel, clay, loam, peat, ash, shale etc. which can generally be excavated by spade, pick axes and shovel and which is not classified under “soft and decomposed rock” and “hard rock” defined below. This shall also include embedded rock boulders not longer than 1 metre in any direction and not more than 200mm. in any one of the other two directions.

##### **(b) Soft and Decomposed Rock**

This shall include rock, boulders, slag, chalk, slate, hard mica schist, laterite and all other materials which in the opinion of Engineer-In-Charge is rock, but does not need blasting and could be removed with picks, hammer, crow bars, wedges and pneumatic breaking equipment. The mere fact that Contractor resorts to blasting for reasons of his own, shall not qualify for classification under “hard rock”.

This shall also include excavation in macadam and tarred roads and pavements and masonry to be dismantled as also rock boulders not longer than 1 metre in any direction and not more than 500 mm. in any one of the other two directions.

##### **(c) Hard Rock**

This shall include all rock occurring in large continuous masses or hard rock with or without veins, plain or reinforced concrete work to be dismantled and boulders of rock occurring in such sizes not classified under (a) & (b) above and which cannot be removed except by blasting for loosening it (although due to proximity of buildings or for any other reasons cutting by good chisels or wedges or by pavement breakers that may have to be resorted to in lieu of blasting).

##### **Method of Excavation**

Depending on the type of material, quantum of excavation and time for construction, the Contractor may carry out the work manually or by use of appropriate mechanical equipment.

The Contractor shall submit his proposal of the method he proposes to adopt for carrying out the excavation work efficiently and expeditiously indicating arrangements for dewatering,

disposal and safety measures etc. for the approval of the Engineer-In-Charge. This approval, however, shall not in any way relieve the Contractor of his responsibility for any consequent loss or damage.

### **Details of Works**

#### **Dimensions / Levels**

Excavation for permanent work shall be carried out to the correct dimensions, lines and levels and profiles shown on the drawings or as directed by the Engineer-In-Charge. Rough excavation shall be carried out to a depth 150 mm. above the final level. The balance shall be excavated with special care. Soft pockets shall be removed even below the final level and extra excavation filled up as directed by the Engineer-In-Charge.

#### **Shoring and strutting**

The Contractor shall provide and maintain all planking and strutting as may be necessary to prevent any ground movement.

#### **Excavation in hard rock**

Excavation in hard rock by blasting shall not be permitted. Excavation in hard rock shall be done manually by machine (chiselling), the rock shall be removed by wedging, barring, heating and quenching or by other approved means. All loose or loosened rock in the sides shall be removed by barring, wedging etc.

#### **Excavation to be kept dry**

The Contractor shall keep all excavation free from water, whether from sub-soil or from rains or from any other source, by pumping or other approved means. When dewatering is done by pumping, the Contractor shall furnish the full details of his scheme for the approval of the Engineer-In-Charge.

#### **Sides and bottom of excavation**

Excavation shall be left open for as short a period as practicable and necessary. Immediately before foundations or other work be constructed therein, the sides of excavation shall be trimmed, if necessary and the bottom shall be cleaned, free of loose or disturbed ground, dry well rammed and approved by the Engineer-In-Charge.

#### **Excess Excavation**

Any excavation beyond the stipulated limits or instructions whether done through error or by accident shall be made good by filling with nominal mix of 1:2:4 concrete to required levels or with earth or murum rammed hard or with masonry as directed by the Engineer-In-Charge without extra cost.

#### **Stacking / Removal of excavated material**

Stacking, dumping, spreading at site or removal from site of excavated material shall be strictly as approved by the Engineer-In-Charge.

Excavated material when stacked shall be at a sufficient distance away from the edge of the excavated pits / trenches so as not to endanger the stability of sides. It should not also obstruct free movement of men, materials and vehicles or encroach upon the area required for construction purposes.

Excavated material suitable for filling shall be dumped in an orderly manner to required levels / grades as directed. All surplus material or material not suitable for filling shall be carried away from site to approved dumping ground.

### **Backfilling**

All return fill in excavated trenches, pits etc. shall consist of materials selected from excavation or elsewhere and shall be dry, friable and free from clay and plastic material, mud, vegetable, salts, sulphates and organic matter likely to decay and shall be subject to the Engineer-In-Charge's approval before use. All clods of earth shall be removed or broken. Where excavated material is mostly rock, it shall be broken to pieces not larger than 150mm size and mixed with properly graded murum or equivalent approved material. Filling shall be placed in layers not exceeding 150mm well watered & consolidated by mechanical compaction machines or manually to achieve 95% proctor density if permitted by the Engineer-In-Charge and to the satisfaction of the Engineer-In-Charge.

If any selected fill material is required to be borrowed from Employer's properties, Contractor shall make arrangements for bringing such material from outside borrow pits. The material and source shall be subject to prior approval of Engineer-In-Charge. The approved borrow pit area shall be cleared of all bushes, roots of trees, plants, rubbish etc. top soil containing salts / sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by Engineer-In-Charge. Contractor shall make necessary access roads to borrow areas and maintain the same, at his own cost if such access road does not exist.

### **Measurements**

Excavation shall be measured as net dimensions in accordance with the instruction by Engineer-in-charge/ Drawings issued specifically for excavation work for foundation / trench excavation where PCC area shall be considered for measurements of excavation. **No measurements** shall be considered for extra excavation that may be required such as **for working space**, for keeping sides of excavation straight etc. or for extra excavation that may result due to removal by blasting, mechanical equipments etc. Founding surface, if uneven, shall be made level with 1:3:6 nominal mix concrete at the Contractors expense.

The depth shall be reckoned from average G. L. of concerned pit / area.

### **Rates**

Rate shall include all materials, labour involved in the above operations as described above including setting out works, profiles, preparing beds for foundations, site clearance, removal of slips/falls, watching and lighting wherever necessary. The rate of excavation is inclusive of dewatering to keep the bed dry irrespective of source of water (such as subsoil water, water table, tidal, rains, seepage, pipe line etc.) shoring if, and when required.

## **3.2. Earthwork in Filling**

### **Material**

All fill material, whether out of surplus material from excavations or brought from any other source outside shall be subject to prior approval of the Engineer-In-Charge. The source of outside material shall also be approved by the Engineer-In-Charge.

All fill material shall be free from vegetable refuse and other organic matter, marine clay, black cotton soil, injurious salt and other material considered unsuitable by the Engineer-In-Charge.

All large clods shall be broken. Where the material is mostly rock, boulders shall be broken into pieces not larger than 15 cm. size, mixed with properly graded fine material like murum etc.

### **Filling over areas (site gradation) / roads /pathways**

Any filling work shall be started by the Contractor only after recording existing ground levels jointly with the Engineer-In-Charge.

Formation width and side slopes shall be as per drawings or as directed by the Engineer-In-Charge.

All banks shall be thrown up in layers of not more than 200 mm. in depth over the whole width between the surfaces of side slopes slightly concave in section, so as to retain water for subsidence. When on side long ground, the whole area of the bank of the slope shall be benched out or stepped so as to prevent material from slipping.

Each layer of filling shall be watered, rammed and thoroughly consolidated to the satisfaction of the Engineer-In-Charge and to obtain the density stipulated in the item. Compaction shall be done by mechanical compaction machines unless otherwise allowed by the Engineer-In-Charge. The normal allowance for subsidence or settlement shall be 5 cm. per 30 cm. depth of bank. This may be increased or decreased by the Engineer-In-Charge depending on the nature of the filling material used. Necessary field and laboratory tests shall be carried out by the Contractor to demonstrate that the specified density at moisture content is obtained in the fill at different stages of filling and after the fill to the entire height is completed, if so specifically called for.

The Contractor shall protect the fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected material and make good the same at his own cost.

If rock obtained from excavation (which may be used for filling and levelling to indicated grades without further breaking) is permitted for filling by the Engineer-In-Charge, filling shall be done in layers not exceeding 50cm approximately. After rock filling to the approximate level, the voids in the rocks shall be filled with finer materials such as earth, broken stone etc. and the area shall be flooded with water so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm. thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 10 -12 tonne roller. No less than twelve passes of the roller shall be accepted before subsequent similar operations are taken-up.

After the filling layers are consolidated, the surface and slopes shall be trimmed to the levels, formation width and to even and uniform gradient as per requirement.

### **Plinth filling**

Plinth filling shall be carried out with approved material in layers not exceeding 15cm. watered and compacted with mechanical compaction machines such as pneumatic tampers, rammers etc. The Engineer-In-Charge may, however, permit manual compaction by hand tampers in case he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surface shall be flooded with water, unless otherwise directed, for at least 24 hours, allowed to dry and then the surface again compacted as specified above

to avoid settlements at a later stage. The finalised level of the filling shall be trimmed to the level/slope as directed / specified.

Where specifically specified, compaction of the plinth fill shall be carried out by means of 8 - 10 tonne approved type of roller. In this case fill layers can be upto a maximum of 300 mm. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill. Rolling shall commence from the outer edge and progress towards the centre and continue until compaction to the satisfaction of the Engineer-In-Charge or provides density not less than that specified in the item but in no case less than 10 passes of the roller shall be accepted for each layer. The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At places back filling shall be carried out with local sand if directed by the Engineer-In-Charge. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer-In-Charge has inspected and approved the fill.

### **Measurement**

**Filling sides of foundations-** The cubical contents of bed concrete levelling course and masonry / concrete in foundations up to the ground level shall be deducted from the cubical contents of earth work in excavation for foundations already measured under the respective item of earth work to arrive at the quantity or filling sides of foundations.

**Filling in plinth and under floor-** Depth of filling shall be consolidated depth. The dimensions of filling shall be on the basis of pre-measurement.

### **3.3. Dry rubble soling**

### **Materials**

Supply of rubble stone of the specified type and size and shall be obtained from approved sources only and transporting to the site of work including all loads, lifts, handling, transportation etc.

The rubble of the specified type of stones shall be hard, tough, sound, durable, dense, clean of close texture and free from unsound material, cracks, decay and weathering. Their water absorption shall be as low as possible but not more than 5 percent.

The shape of the stones shall be as regular as can be obtained by quarrying without attempt at shaping or dressing. They shall be sufficiently flat bedded. The stone shall be broken with the smallest dimensions equal to the specified thickness of soling. The length and breadth should not generally exceed twice its thickness. Before starting collection, the contractor shall get a sample conforming to the required quality, shape and size approved by the Engineer-In-Charge who will keep it in his office for reference.

Stacking shall be done only after the quality; shape and size of rubble are approved.

The hard murum used as binding material shall be of disintegrated trap, granite, quartzite or gneiss rock freshly quarried. It shall be sufficiently hard and free from soft murum, earth, organic matter or other deleterious or soft material. The particle size of the hard murum shall generally fulfil the size (Square mesh) percentage passing through, 80mm - 95% and 25mm - 2%. Stacking lift and lead etc. shall be as specified in the BOQ, or as directed by the Engineer-In-Charge.

## **Laying Soling**

The item provides for the labour for laying soling of specified type of stones in the specified thickness including preparing the sub-grade to proper sections by scrapping, dressing, compaction, etc. and hand packing the rubble chips to the required line, curve and grade and section.

The rubble supplied shall be laid with the largest face downwards and in contact with each other. The stones shall break joint as far as possible. The full thickness of the soling shall generally be made with one stone only. Unless otherwise provided in the plans or directed by the Engineer-In-Charge, the width of the soling shall be 30cm more than that of the metal above.

As the laying of rubble advances the soling shall be hand packed by wedging and packing with 80mm metal collected for the purpose in the joints of the soling and driving them by hammers in place so as to fill the voids as completely as possible. This operation of hand packing shall follow the rubble laying closely. The soling shall be laid and hand packed true to grade and section and these shall be often checked by boning rods, template boards and fish lines, etc. The grades sections etc. of the soling shall correspond to those of the surfacing coming on it.

The soling thus laid shall be finished by knocking out projecting stones and filling depressions by chips to come up to the grade and camber.

## **4. MORTARS**

### **4.1. Cement**

#### **Standard**

Cement to be used in the Works shall be conforming to the following IS standards codes-

- 43 Grade Ordinary Portland Cement : IS 8112
- Portland Pozzolana Cement ( fly ash based) : IS 1489 (part-I)

#### **Supply & Storage**

The cement to be used on works shall be OPC or PPC (fly ash based) as specified.

Unless otherwise specified, Ordinary Portland Cement or PPC shall be supplied in bags containing 50 Kg. each.

Stacking of cement rejected due to aging or not fulfilling IS requirements shall be at the cost of the Contractor. Cement held in storage for a period of 90 days or more shall be re-tested before use.

#### **Tests**

A certified report, attesting the conformance of the cement to IS Specifications by the cement manufacturer shall be furnished to the Engineer-In-Charge, by the contractor.

Samples of cement shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be as per **IS 3535**. Tests shall be carried out for fineness, initial and final setting time and compressive strength as per **IS 4031**.

Supplier of cement shall furnish the following documents before the cement is delivered to site –

Certificate conforming that chemical composition and physical characteristics are within the stipulated values for types of cement supplied as per relevant codes.

Certificate conforming that the chloride content in the cement is not in excess of 0.05 per cent of mass of cement.

If during subsequent testing of cement supplied in lots any of the properties are found to be outside the acceptable limits, the lot of cement shall be rejected.

Each 1000 bags or part thereof of cement, or each wagon load of cement shall constitute one lot of cement for the purpose of conducting tests at site.

Samples for testing at site shall be taken at random from 2% of the total quantity supplied in one lot. For cement supplied in bags, samples shall be drawn from minimum of 5 bags and the 2% value shall be rounded to the next higher integer. For bulk cement, sampling shall be done with the help of slotted sampler to be as per IS 3535.

Results of test conducted on samples drawn shall be submitted to the Engineer-In-Charge for his approval. If in the opinion of the Engineer-In-Charge, the test results are not within permissible limits, the lot of cement from which samples have been obtained for testing shall stand rejected and the material shall be removed from site.

Following tests shall be conducted at site on each lot of cement delivered:

**TABLE 1**

<b>Mandatory tests</b>	<b>Number of test/lot</b>
1 Consistency of standard cement paste	5
2. Initial and final setting time	5 each
3. Compressive strength test	10

Mean values of the results from the above results shall be taken as the representative value and the acceptance criteria shall be based on these test. All test procedures and computation of test results shall be as per IS 4031.

Apart from mandatory tests specified as above, the Engineer-In-Charge may at his discretion, call for any additional tests that he may consider necessary. All such tests shall be done on representative samples taken from each lot described above para and testing and computation of test results shall be done as per IS 4031. Charges for such testing shall be born by the contractor.

#### **4.2. Fine Aggregate**

##### **Standard**

Fine aggregate for different end uses (other than lightweight concrete) shall conform to the following standards:

- For Structural Concrete - IS: 383 (between Grading Zones I & II)
- For Mortar & Grout - IS: 2116
- For Plastering - IS: 1542 (Class A grading)



Fine aggregate shall consist of natural sands or machine crushed rock/gravel. It shall be clean, sharp, hard, strong and durable and free from dust, vegetable substances, adherent coating, clay, loam, alkali, organic matter, mica, soluble sulphate, gypsum or any other deleterious substances which can be injurious to the setting qualities / strength / durability of concrete. **Use of sea sand is prohibited.**

### Storage

Fine aggregates shall be stored at site in adequate quantity on clean and well maintained hard floor and areas not liable to flooding. Contamination with foreign matter and earth shall be avoided during storage and while heaping the materials.

### Usage

Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious matter is within the permissible limits as laid down in IS 2386 (Part-II).

Screening of sand shall be done if necessary, and as and when directed by the Engineer-In-Charge to remove all objectionable foreign matter and effecting any grading.

### 4.3. Water

#### Standard

Water supplied shall conform to the various provisions detailed under Clause 5.4 of IS 456:2000. Broadly stated water used for mixing and curing as also for cooling / washing of aggregates shall be clean and fresh, free from oils, acids, alkalises, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Sea water or water from excavation shall not be used.

Potable water is generally considered satisfactory for mixing concrete. As a guide the following concentration represent the maximum permissible values:

To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5ml of 0.02 normal NaOH. The test shall be conducted as detailed in 8.1 of IS 3025 (Part 22).

To neutralize 100ml sample of water, using mixed indicator, it should not require more than 25ml of 0.02 normal H<sub>2</sub>SO<sub>4</sub>. The test shall be conducted as detailed in 8 of IS 3025 (Part 23).

Permissible limits for solid content shall be as given in the table below:

**TABLE 2**

SI. No.	Particulars	Tested as per	Permissible limits Max
i)	Organic	IS 3025 (Part 18)	200 mg/l
ii)	Inorganic	IS 3025 (Part 18)	3000 mg/l
iii)	Sulphates (as SO <sub>3</sub> )	IS 3025 (Part 24)	400 mg/l
iv)	Chlorides(as Cl)	IS 3025 (Part 32)	2000 mg/l for concrete not consisting embedded steel & 500 mg/l for reinforced concrete work
v)	Suspended matters	IS 3025 (Part 17)	2000 mg/l

**Storage**

Water shall be so stored that it remains free from all deleterious materials as mentioned above.

**Tests**

No water shall be used until tested for its chemical and other impurities in accordance with IS 3025 to ascertain its suitability. Tests shall be conducted whenever the source is changed or during seasonal variation.

**4.4. Mortar Mixing**

Cement and sand in the specified proportion shall be mixed in dry thoroughly by using mechanical mixer or by hand mixing, if permitted. Composition (cement and sand mortar, or lime and sand mortar or cement, lime and sand mortar) and proportions of mortars shall be as specified in the respective items of work. The ingredients of the mortar shall be accurately gauged by measure.

**Precaution**

Mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

## 5. PLAIN CEMENT CONCRETE (PCC) WORKS

### 5.1. Cement

Cement shall be as specified under –Mortars specifications.

### 5.2. Aggregate

#### 5.2.1. Coarse Aggregates

##### 1 Standard

Coarse aggregate for use in concrete (other than light weight concrete) shall conform to IS 383.

Coarse aggregate shall have a minimum specific gravity of 2.6 (saturated surface dry basis). Aggregate below this specific gravity shall not be used without specific permission of the Engineer-In-Charge.

Coarse aggregate shall consist of natural or crushed stone, angular in shape with granular or crystalline surfaces or approved river shingle or gravel, rounded in shape. All aggregate shall be clean and free from elongated, friable, flaky or laminated pieces, adherent coatings, clay lumps, mica, organic matter and any other deleterious matter that may cause corrosion of reinforcement or impair the strength and / or durability of concrete. It shall be chemically inert, hard, strong, dense, and durable against weathering.

The maximum quantities of deleterious materials in the coarse aggregate shall not exceed the limits indicated in the IS 383 when tested as per IS 2386 Part-I & Part-II “Method of Tests for Aggregate for Concrete”.

#### Source

Once a specific source of supply of coarse aggregate is accepted, the source shall not be changed without prior approval of the Engineer-In-Charge.

Supplier of aggregates shall furnish the following information before the material is delivered to site:

Precise location of source from where the material is to be supplied

Trade group of principal rock type as per table given below

Presence or reactive minerals.

**TABLE 3**

Trade group names of aggregates	Granite, Gabbro, Dolerite, Rhyolite,
To be used for concrete	Basalt, Quartzite, Gneiss

The supplier shall also furnish reports of test results giving the following information for approval to Engineer-In-Charge before delivery of material at site:

- Specific gravity
- Bulk density
- Moisture content
- Absorption value
- Aggregate crushing strength
- Aggregate impact value
- Abrasion value
- Flakiness index
- Elongation index

- Limits of deleterious substances in the aggregate
- Soundness of aggregate
- Potential reactivity of aggregates.

### **Storage**

Coarse aggregate of available sizes shall be stored at site as separate stacks over clean and well maintained hard floor and areas not liable to flooding. Alternatively they will be stored in bins.

Contamination with foreign materials and earth during storage and while heaping the materials shall be avoided. It shall be kept in layers not exceeding 1.2 m in height to prevent coning or segregation.

### **Usage**

Coarse aggregate, which is not clean, shall be washed with clear fresh water before use in the job. Screening would be done if considered necessary by the Engineer-In-Charge without extra cost.

### **Tests**

All test shall be conducted in accordance with IS 2386 (Part I to VIII).

The Engineer-In-Charge may at his discretion, call for any additional tests that he may consider necessary. Sampling, procedure and computations for such test shall be done in accordance with IS 2430 and IS 2386 as applicable.

#### **5.2.2. Fine Aggregates**

Fine aggregates shall be as specified under –Mortars specifications.

#### **5.2.3. Water**

Water shall be as specified under –Mortars specifications.

#### **5.2.4. Fly Ash :**

Fly ash shall be as specified under -Mortars specifications.

#### **5.2.5. Admixtures :**

Admixtures if required, shall be as specified under RC Concrete specifications.

#### **5.2.6. Placing of Cement Concrete**

Placing of cement concrete shall be as specified under- Reinforce Cement Concrete specifications (relevant as applicable). All concrete shall be protected against damage until final acceptance by the Engineer-In-Charge.

### **5.3. Formwork**

Formwork may be of timber, plywood, steel or other metal, plastic or concrete or any suitable material as per the direction of Engineer-In-Charge.

Formwork (or shuttering) comprises all forms and moulds made up of planks and sheeting etc., shores, bracings and struts, ties, anchors and hangers, steel rods, bolts and allied inserts, uprights, walling, wedges and all other temporary supports for concrete work during the process of concreting and setting.

Form work design parameters and specifications shall be as specified under- Reinforce Cement Concrete (relevant as applicable).

#### **5.4. Measurement**

All measurements shall be as per relevant part of IS 1200. Any work done in excess over the specified dimensions or sections shown in the drawing shall be ignored.

Concrete work executed under water, in liquid mud or under foul positions shall be measured separately as instructed by the Engineer-In-Charge.

No deductions shall be made for- Opening upto 0.1 sq.m, volume occupied by pipes, conduits, sheathing, small voids etc.

## 6. REINFORCED CEMENT CONCRETE

### 6.1. Cement

Cement shall be as specified under - Mortars specifications.

### 6.2. Coarse Aggregate

Coarse Aggregates shall be as specified under- Mortars specifications.

### 6.3. Fine Aggregate

Fine aggregates shall be as specified under- Mortars specifications.

### 6.4. Water

Water shall be as specified under –Mortars specifications.

### 6.5. Fly Ash :

Fly ash shall be as specified under –Mortars specifications.

### 6.6. Admixtures

#### 6.6.1. General :

Admixtures if permitted shall comply with IS 9108 Concrete admixtures are proprietary items of manufacturer and shall be obtained from established / approved manufacturers.

Admixtures should not impair durability of concrete nor combine with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

The workability, compressive strength and slump with and without use of admixtures shall be established during the trial mixes prior to use of admixtures.

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

The chloride content of admixtures shall be independently tested for each batch before acceptance.

If two or more admixtures are used simultaneously in the same concrete mix, data shall be obtained to assess their interaction and to ensure their compatibility.

The Contractor shall provide the following information concerning each admixture after using the same from the manufacturer:

Normal dosage and detrimental effects, if any, of under dosage and over dosage.

The chemical names of the main ingredients in the admixtures.

The chloride content, if any, expressed as a percentage by the weight of the admixture.

Values of dry material content, ash content and relative density of the admixture which can be used for uniformity tests.

Whether or not the admixture leads to the entrainment of air when used as per the manufacturer's recommended dosage and of so to required extent.

Where two or more admixtures are proposed to be used on any one mix, confirmation as to their compatibility.

Assurance with documentary evidence to show that there would be no increase in risks of corrosion of the reinforcement or other embedment as a result of using the admixture.

In addition the following conditions also shall be satisfied:

“Plasticizers” and “super-plasticizers” shall meet the requirements indicated for “water reducing admixtures”.

Except where resistance to freezing and thawing and to disruptive action of de-icing salts is necessary, the air content of freshly mixed concrete in accordance with the pressure method given in IS 1199 shall be not more than 2% higher than that of the corresponding control mix and in any case not more than 3% of the test mix.

The chloride content of the admixture shall not exceed 0.2% when tested in accordance with IS 6925. In addition, the maximum permissible limit of chloride content of all the constituents of concrete as indicated in IS 456:2000 shall also be observed.

Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch of different items.

The tests that shall be performed with permissible variations in the same are indicated below:

Dry material content: to be within 3% and 5% of liquid and solid admixtures respectively of the value stated by the manufacturer.

Ash content: to be within 1% of the value stated by the manufacturer.

Relative density (liquid admixtures) : to be within 2% of the value stated by the manufacturer.

All tests relating to the admixtures if required shall be conducted periodically as decided by the Engineer-In-Charge at an independent laboratory and compared with the data given by the manufacturer.

## **6.6.2. Material Admixtures**

### **Pozzolana**

Pozzolonic materials conforming to IS 3812 may be used with the permission of the 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 of replacement of Ordinary Portland cement provided uniform blending with cement is ensured.

### **Silica fume**

Silica fume conforming to standard acceptable to the Engineer-In-Charge may be used as part replacement of cement provided uniform blending with cement is ensured.

### **Rice husk ash**

Rice husk ash giving required performance and uniformity characteristics may be used with the approval of the Engineer-In-Charge.

### **Metakoline**

Metakoline having fineness between 700 to 900sq.m per kg may be used as Pozzolonic material in concrete.

### **Ground granulated blast furnace slag (GBSS)**

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 ensured.

## **6.7. Placing of Concrete – (Plain & Reinforced)**

### **Grades of Concrete**

Various grades of concrete shall be as per **IS 456 - 2000 (latest)** with specified characteristic compressive strength against these grades in accordance with Table 2 in the said IS. In the grade designation, letter '**M**' refers to the mix and the number to the specified characteristic compressive strength of 15 cm. cube at 28 days expressed in N/mm<sup>2</sup>. The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

The mix shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than appropriate values given in Table 2 of IS 456:2000. The target mean strength of concrete mix should be equal to the characteristic strength plus 1.65 times the standard deviation.

### **Design Mix Concrete**

All RC work shall be in "Design Mix Concrete" only. The Contractor shall make all the necessary tests from approved authorized laboratories like VJTI, IIT, Sardar Patel College, etc. to determine for each grade of concrete, the proportions of various ingredients by weight to arrive at the desired design mix to the satisfaction of the Engineer-In-Charge. Such mix will be known as the "declared mix". No deviation from the "declared mix" will be permitted without the approval of the Engineer-In-Charge. Approval by the Engineer-In-Charge to such "declared mix" shall not relieve the Contractor of his responsibility to use in the Works at all times only concrete as specified in the relevant drawings.

The Contractor shall be entirely responsible for design of concrete mixes of the specified performance to suit the degree of workability and characteristic strengths required for the various parts of the Works.

Concrete shall meet with the strength requirements and minimum cementations material, maximum w/c ratio as indicated in TABLE 5 of IS 456:2000 hereinafter unless specifically stated otherwise.

Alternative mixes may be designed by the Contractor for use in both thin and narrow sections and thick sections. Special mixes using finer aggregates may be designed by him for in filling pockets and narrow spaces and for regions of congested reinforcement.

### **Nominal Mix Concrete**

Nominal mix concrete may be allowed by the Engineer-In-Charge at his discretion. The proportions of materials shall be in accordance with Table 9 of IS 456-2000. The relevant details at a glance are indicated in given below in Table 4.

**TABLE - 4**

<b>Grade of Concrete</b>	<b>Total quantity of dry aggregates by Mass per 50kg of Cement, to</b>	<b>Quality of water per</b>
--------------------------	------------------------------------------------------------------------	-----------------------------



	<b>be taken as the sum of the individual Masses of Fine &amp; Coarse Aggregate, Kg, Max.</b>	<b>50Kg. of cement, Max.</b>
M 10	480 Kg.	34 Litres
M 15	350 Kg.	32 Litres
M 20	250 Kg.	30 Litres

The proportion of fine aggregate to coarse aggregate by mass shall generally be 1:2 subject to an upper limit of 1:1 ½ and lower limit of 1:2 ½.

**TABLE - 5**

<b>I.S. Sieve Designation</b>	<b>Percentage passing for single sized aggregate of nominal</b>					<b>Percentage passing for graded aggregate of</b>			
	<b>40 mm.</b>	<b>20 mm.</b>	<b>16 mm.</b>	<b>12.5 mm.</b>	<b>10 mm.</b>	<b>40 mm.</b>	<b>20 mm.</b>	<b>16 mm.</b>	<b>12.5 mm.</b>
63 mm.	100	-	-	-	-	-	-	-	-
40 mm.	85-100	100	-	-	-	95-100	100	-	-
20 mm.	0-20	85-100	100	-	-	30-70	95-100	100	100
16 mm.	-	-	85-100	100	-	-	-	90-100	-
12.5 mm.	-	-	-	85-100	100	-	-	-	90-100
10 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	0-5	0-10	0-10	0-10
2.36 mm.	-	-	-	-	0-5	-	-	-	-

### **Mix Design & Proportioning**

Mix proportions shall be designed to ensure that the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcements and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability and impartibility.

Determination of the proportions by weight of cement, aggregates and water shall be based on design of the mix.

As a trial the manufacturer of concrete may prepare a preliminary mix according to provisions of SP: 23-1982.

All concrete proportions for various grades of concrete shall be designed separately and the mix proportions established keeping in view the workability for various structural elements, methods of placing & compacting.

### **Standard Deviation**

Standard deviation calculations of test results based on tests conducted on the same mix design for a particular grade designation shall be done in accordance with clause 9.2.4 of IS 456.

### **Acceptance Criteria**

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

1.2 The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col. 2 of Table 6 of IS 456 - 2000.

1.3 Any individual test result complies with the appropriate limits in column 3 of Table 6.

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

1.4 The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least  $0.3 \text{ N/mm}^2$

1.5 The strength determined from any test results is not less than the specified characteristic strength less  $0.3 \text{ N/mm}^2$

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 col. 3 of Table 6 or in item (b) of above 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 60 cub. m

If the concrete is deemed not to comply pursuant to quality of concrete represented by strength Test result as above, the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.

### **Cement content of concrete**

For all grades of concrete manufactured / produced, minimum cement content in the concrete shall be 310 kg per cubic metre of concrete. Also, irrespective of the grade of concrete, the maximum cement content shall not be more than 500 kg per cub. m of concrete. These limitations shall apply for all types of cements of all strengths.

Actual cement content in each grade of concrete for various conditions of variables shall be established by design mixes and approved by the Engineer-In-Charge.

### **Approval of Design Mix**

The contractor shall submit details of each trial mix of each grade of concrete designed for various workability conditions to the Engineer-In-Charge for approval. Concrete of any particular design mix and grade shall be produced / manufactured for works only on obtaining approval of the Engineer-In-Charge.

For any change in quality/quantity in the ingredients of a particular concrete for which mix has been designed earlier and approved by the Engineer-In-Charge, the mix has to be redesigned and approval shall be obtained again.

### Quality Assurances Measures

In order that properties of the completed structure be consistent with the requirements and the assumptions made during planning and design adequate quality assurance measures shall be taken. Quality Assurance procedures be developed and submitted to the approval of Engineer-In-Charge. The said Quality Assurance plan shall fulfil the requirements detailed under clause no. 10.1 of IS : 456 - 2000.

### Proportioning & Batching

Preliminary tests shall be carried out to determine the proportions by weight of cement, coarse and fine aggregate to produce the desired grade of concrete. These proportions shall be maintained during subsequent concrete batching by means of weight batchers conforming to IS 2722.

The accuracy of the measuring equipment shall be within  $\pm 2$  percent of the quantity of cement being measured and within  $\pm 3$  percent of the quantity of aggregate, admixtures and water being measured.

The batcher shall be tested for accuracy of calibration before commencement of the work and at least once a week thereafter or more frequently, if so required by the Engineer-In-Charge.

All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked.

### Grading of Aggregate & Foreign Material Limitations

#### Coarse Aggregate

- Coarse aggregates shall be either in single size or graded; in both cases, the grading shall be within acceptable limits .
- The percentages of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the volumes given in table here below.

**TABLE - 6**

Deleterious Substance	PERCENT BY	
	Uncrushed	Crushed
i) Coal & Lignite	1.00	1.00
ii) Clay lumps	1.00	1.00
iii) Material finer than 75 micron	3.00	3.00
iv) Soft fragments	3.00	--
v) Shale	--	--
vi) Total of percentages of all the deleterious materials (except mica) including SI no. (i) to (v)	5.00	5.00

#### Fine Aggregate

- Unless otherwise directed or approved, the grading of sand shall be within the limits indicated in table here below.

**TABLE - 7**

<b>I.S. Sieve Designation</b>	<b>Grading Zone-I % passing</b>	<b>Grading Zone - II % passing</b>	<b>Grading Zone - III % passing</b>	<b>Grading Zone - IV % passing</b>
10 mm.	100	100	100	100
4.75 mm.	90-100	90-100	90-100	95-100
2.36 mm.	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	80-100
300 micron	5-20	8-30	12-40	15-50
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 total amount not exceeding 5 percent, 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.

Fine aggregate 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 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.

- The percentage of deleterious substances in sand delivered to the mixer shall not exceed the values given in table here below:

**TABLE - 8**

<b>Deleterious Substance</b>	<b>PERCENT BY</b>	
	<b>Uncrushed</b>	<b>Crushed</b>
i) Coal & Lignite	1.00	1.00
ii) Clay lumps	1.00	1.00
iii) Material finer than 75 micron	3.00	15.00
iv) Soft fragments	--	--
v) Shale	1.00	--
vi) Total of percentages of all the deleterious materials (except mica) including SI no. (i) to (v) for uncrushed and SI. No. (i) & (ii) for crushed fine aggregate.	5.00	2.00

### Water Cement Ration (W/C Ratio)

- The water-cement ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix. Free water-cement ratio should not exceed 0.40 for substructure and 0.45 for superstructure unless otherwise specified.
- Only such quantity of water shall be added to the cement / cementations material and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. 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.
- The actual water-cement ratio to be adopted shall be determined in each instance by the Contractor & approved by the Engineer-In-Charge.

The W/C ratio determined and approved for use by the Engineer-In-Charge shall be maintained throughout the corresponding part of the Works. Approved tests conforming to relevant IS Codes subject to approval of Engineer-In-Charge shall be undertaken periodically by the Contractor for maintaining the consistency. Such ones comprise frequent determination of the water content of the aggregate during the progress of work as specified in IS 2386 (Part-III). To allow for the variation in weight of aggregates due to variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

- The Contractor shall exercise special precautions on the water content for concrete work since the colour of such concrete is sensitive to small variations of water in the mix.

Volumetric mixing may be allowed by the Engineer-In-Charge at his discretion by converting the “declared mix” to corresponding mix by volume. Allowance for bulkage shall be made in accordance with IS 2386(Part 3). Periodic checks shall be made on mass / column relationship of the materials. Similarly where cement is measured by bags directly reasonable number of cement bags should be weighed periodically to check the net mass as directed by the Engineer-In-Charge.

### Workability

- Workability of concrete should be checked at frequent intervals. It shall be checked at frequent intervals by approved tests such as slump tests, compacting factor tests etc. in accordance with IS 1199. If required the same shall be controlled by adjusting the dosage of the admixtures if permitted by the Engineer-In-Charge.
- The range of slumps for various types of work shall generally be as follows subject to approval by the Engineer-In-Charge unless stated otherwise. Slump required for workability shall be achieved, if necessary by using approved super plasticizer without any extra cost.

**TABLE - 9**

Placing condition	SLUMP (in mm.)	
	Maximu m	Minimu m
Blinding concrete; shallow sections; Pavement using Pavers	75	25
Mass concrete; Lightly reinforced sections in slabs, beams, walls, columns, Floors, hand	75	25

placed pavements, Strip footings		
Heavily reinforced sections in slabs, beams, walls, columns; Slip formwork, Pumped concrete	100	50
Trench fill; In-situ piling	100	75
	150	100
<b>Note:</b> For most of the placing conditions, internal vibrators (needle vibrator) are suitable. The diameter of the needle shall be determined based on the density and the spacing of reinforcement bars and thickness of the sections. For trieme concrete, vibrators are not required to be used and clause 7.1.2 of IS : 456 - 2000 shall be followed in such case.		

#### i) **Mixing of Concrete**

All concrete whether design mix or nominal mix shall be mixed in an approved mechanical mixer. The mixer shall comply with IS : 1791 & IS : 12119. The mixer shall be fitted with water measuring (metering) devices.

Material for concrete shall be deposited into the mixer drum while it is in rotation in the following order.

#### **Coarse aggregate, cement, fine aggregate and water**

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 not be remixed.

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

The volume of mixed material shall not exceed the manufacturer's rated mixer capacity.

Temperature of aggregate, water and cement when added to the mixer shall be such that the temperature (minimum & maximum) of the concrete at the time of placement shall be as specified in IS 456: 2000

The mixer shall be thoroughly cleaned of all hardened sticking concrete and foreign materials before beginning the concreting operations and also at frequent intervals between batches and at the end of concreting work by spraying the drum with cool water.

Concrete shall be discharged from the mixer on to a level, clean and water-tight surface. The area surrounding the mixer and the aggregate stacks shall be kept clean.

Subject to the approval of the Engineer-In-Charge, the Contractor may use waterproofing admixtures and / or other chemical admixtures and additives in concrete. The proportions and the mode of use shall be as per the manufacturers' instructions. The Contractor shall furnish complete literature in regard to such admixtures / additives to the Engineer-In-Charge.

Dosage of retarders, plasticizers and super-plasticizers shall be as per manufacturer's requirement and subject to approval of the Engineer-In-Charge. Unless otherwise specified. It shall be restricted to 0.5, 1.0 and 2.0 percent respectively by weight of cementations materials unless a higher value is permitted by the Engineer-In-Charge. Approval of mix design shall be by the Engineer-In-Charge prior to actual executions.

Mixing of cement mortar or concrete which has partially set shall not be permitted under any circumstances.

#### **ii) Transporting and Placing of Concrete**

Concrete shall be handled from the place of mixing to the place of final placing as rapidly as practicable by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability. Entire operation shall not take time more than the initial setting time of concrete under the prevailing site conditions.

During hot or cold weather, concrete shall be transported in deep containers. Other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

The concrete shall be deposited as nearly as practicable in its final position to avoid re-handling. No concrete shall be permitted to be used in the Works after initial set has taken place. Concreting of beams, slabs and similar members shall be carried out in one continuous operation to the full depth of the member and the sequence of placing shall be so arranged as to avoid disturbance of partially set concrete.

Method of placing of concrete should be such that no segregation occurs during placing. Generally concrete shall not be dropped freely from a height of more than 1.2 meters in the works of watertight structures and 1.6 m. in all other works. When required to be deposited from a greater height, it shall be done through a metal-lined chute with slope no flatter than 1:3 (vertical : horizontal) and not steeper than 1:2. The discharge end of the chute will be provided with a baffle plate to prevent segregation. The discharge end of the chute shall be maintained above the surface of the concrete in forms and concrete shall not be permitted to fall from the end of chute by more than 1 m. During cleaning a chute, the waste water shall be kept clear of the forms.

#### **iii) Compaction of Concrete**

Except for thin layer of plain concrete (for which tamping may be allowed), each layer of all grades / mixes of concrete shall be thoroughly compacted with approved mechanical vibrators of adequate power or as per IS 2505, IS 2506, IS 2514 supplemented by hand spreading, rodding and tamping as directed so that concrete works around the reinforcement, around entrapped fixtures and into corners of the formwork, embedded air is expelled, dense concrete is obtained and the exposed surfaces are free from air pockets, honey-combing and other defects.

Type of vibrators (immersion vibrators, shutter vibrators, surface vibrators etc.) to be used shall depend on the type of structure for which concreting is done and shall have the approval of the Engineer-In-Charge. The size and number to be provided shall be such as to ensure proper consolidation.

General precautions to be taken in vibration work shall be as follows-

- Concrete once vibrated shall not be vibrated again.
- Partially hardened concrete or mortar shall not be re-tamped.
- Over-vibration, under-vibration or vibration of very wet mixes should be avoided.
- Tapping or external vibration of forms by hand tools or immersion vibrators shall not be permitted.
- Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. These vibrators shall not be allowed to come in contact with the reinforcement

steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

- Whenever external vibrators are used, the design of formwork & the disposition of vibrators should be given special consideration to ensure sufficient compaction and surface blemishes.

#### **10) Concreting in Inclement Weather**

During heavy rains, concreting shall be stopped keeping appropriate temporary stop ends and newly cast concrete shall be instantly covered by suitable protective means. Any concrete damaged due to rainstorms etc. shall be replaced appropriately as directed by the Engineer-In-Charge at the expense of the Contractor.

#### **11) Concreting under water**

When it is necessary to deposit concrete under water, the Contractor shall submit to the Engineer-In-Charge for his approval the method of carrying out the work together with the materials and proportions thereof he propose to use. In no case such concrete be considered as "Design Mix Concrete"

#### **12) Curing**

All concrete shall be protected during hardening from the harmful effects of sunshine and drying winds. All exposed surfaces of newly placed concrete shall be kept continuously in a damp or wet condition by water ponding or by covering with a canvas, hessian or similar other water absorbent materials and kept continuously wet for at least seven days from the date of placing of concrete. Likewise all formwork directly in contact with concrete shall be kept dry. Curing compounds to provide surface coating with speckling equipment may also be used if permitted by the Engineer-In-Charge. The necessary literature shall be furnished by the Contractor for the purpose.

For in-situ slabs (whether for flat roofs or other level surfaces, floors, pavements, side walks etc.), curing shall be by ponding only.

The curing period for water-tight structure shall be 10 days. In the case of concrete where mineral admixtures or blended cements are used the curing period shall be extended to 14 days.

The Contractor shall take good care in the arrangement (whether by continuous fine mist spraying or sprinkling or by covering with clean sand or wet gunny bags or by any curing compounds) and execution of curing so that curing will be carried out without interruption during the nights, Sundays and holidays.

Water for curing shall be of the same quality as used for concrete.

#### **13) Expansion Joints**

Expansion joints in the watertight structures shall always be provided with water-stop for the entire length of joints unless otherwise specified or as specified in the item description. The work shall be carried out in strict accordance with the manufacturer's instructions.

#### **14) Construction Joints & Keys**

Concrete shall be placed without interruption until completion of the part of the work between predetermined construction joints as specified hereinafter. Time lapse between the



pouring of adjoining units shall be as specified on the drawings or as directed by Engineer-In-Charge.

If stopping of concreting becomes unavoidable anywhere, properly formed construction joints shall be made along where the work is stopped. These joints shall be either vertical or horizontal, unless shown otherwise on drawings. In case of an inclined or curved member, the joint shall be at right angles to the longitudinal 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 formwork to ensure a horizontal line and if directed shall also be used to form a grooved joint. For tank walls and similar work joints shall be formed as per IS 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 joint shall be in accordance with the following.

### **Column Joint**

In a column, the joints 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 columns, piers or walls, before depositing in beams, girders or slabs supported thereon.

### **Beam & Slab Joint**

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 on drawings. 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 unavoidably at right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.

### **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 water tightness.

Where the work has to be resumed on a surface which has hardened, any skin or laitance shall be removed and the surface roughened by hammering with an approved power-operated "bush" hammer followed by wire brushing to remove all loose practices. When using this procedure, great care shall be taken to avoid disturbing concrete matrix. The surface is then thoroughly wetted. Fresh concrete should thoroughly be vibrated near the construction joint 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 key may be provided. Sprayed curing membranes and release agents should be thoroughly removed from joint surfaces.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire on bristle brushes or by using water jets, care being taken to avoid dislodgment of particles of aggregate. The prepared surface should be in a clean saturated surface dry condition when fresh concrete is placed, against it. Fresh concrete shall be thoroughly vibrated near construction joint so that mortar from new concrete flows between large aggregates and develop proper bond with old concrete.

#### **iξ) Sampling & Testing of Concrete**

Arrangement shall be made by Contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Engineer-In-Charge.

#### **ξ) Concrete Below Specified Strength**

Should the concrete tests fail to meet the minimum specified strength requirements for the respective grades of concrete, the Engineer-In-Charge may take one of the following decisions –

Instruct the Contractor to carry out such additional tests (e.g. NDT test, core test, load-test etc.) and/or remedial measures to ensure the soundness of the structure at the Contractor's expense.

The Engineer-In-Charge may accept the work provided it meets the relevant acceptance criteria as stipulated in IS 456-2000. Any decision to accept the work shall be entirely at the discretion of the Engineer-In-Charge who may make a reduction in the rate of the appropriate item.

The work will be rejected and any consequential action as needed shall be taken at the Contractor's expenses including cutting out and replacing a part or whole of the work.

#### **ξi) Repair & Replacement of unsatisfactory Concrete**

Immediately after the shuttering is removed, the surface of concrete shall be carefully inspected and all defective areas called to the attention of Engineer-In-Charge who may permit patching of the defective areas or also reject the concrete unit either partially or fully shall be attended. Rejected concrete shall be removed and replaced by Contractor at No additional expense. Holes left by 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 2.36 mm. IS sieve after removing loose stones adhering to the concrete. Mortar filling shall be struck off flush at the face of the concrete. Concrete surfaces shall be finished as described under the particular items 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 pores shall be filled in. The mortar shall be well worked into the surface with a 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 surface. Surface irregularities shall be removed by grinding.

#### **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

instructions of the manufacturer. Only flexible epoxy shall be permitted with certain minimum solid contents as recommended by the Engineer-In-Charge. The use of epoxy if any shall be at no extra cost to the Employer.

### **Method of Repair**

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The holes to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

Before surface treatment, grouting may have to be done by equal strength shrinkable grout. Unless otherwise specified, 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 prod 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 flat and a smooth finish obtained by wiping with hessian, a steel trowel shall 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 too 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 Engineer-In-Charge, to match the shade of the patch with the original concrete.

### **Curing of patched work**

The patched area shall be covered immediately with an approved water retaining, 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 or sprinkling for not less than 10 days.

### **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 be tightly bonded to the concrete and shall be sound, free from cracks after the fillings have been cured and dried.

### **ξ1) Finishing**

This specification is intended to cover the treatment of concrete surfaces of all structures. Areas requiring special finish not covered by this specification shall be clearly indicated on the drawings and special specifications, if any shall be furnished by the contractor for approval.

### **Finish for Formed Surfaces**

The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified.

For surface 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 waterproofing material, 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 level, shall be sloped for drainage. Unless the drawing specifies a horizontal surface or shows the slope required, the tops of narrow surface such as stair treads, walls, curbs and parapets shall be sloped across the width approximately 1 in 30. Broader surface 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 smoothing screened and levelled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tiles toppings such as outside decks, floors of galleries and sumps, parapets, gutters, side walks, floors and slabs, shall be consolidated, screened 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 screened surface has attained the 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 the Engineer-In-Charge.

### **Protection**

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

### **Measurement**

Dimensions shall be measured to a cm except for the thickness of slab which shall be measured correct to 0.50cm. The areas shall be worked out nearest to 0.01 sq.m.

The cubical contents shall be worked out to nearest 0.01 cubic meter. Reinforced cement concrete shall be classified under different category and measured as categorized in the item description.

No deductions shall be made for-

- i) Ends of dissimilar material( e.g. joist, beams, post girders, rafters, purlins, corbels, steps etc.),
- ii) volume occupied by water pipes, conduits etc. Nothing extra shall be paid for leaving and finishing such cavities and holes.
- iii) The concrete displaced by the reinforcement, inserts shall not be deducted.
- iv) No deduction shall be made for openings less than 0.10 Sq.m. in area where concrete is measured in Sq.m. and 0.02 Cu.m. where concrete is measured in Cu.m.

The measurement of RCC work between various units shall be regulated as below-

a) Footings (sloped) –

$$\text{Volume} = h / 3 (A1 + A2 + \sqrt{A1 \times A2})$$

Where A1 & A2 are areas at top and bottom respectively and h = perpendicular height of the trapezoidal portion.

b) Slabs -

They shall be measured full on superficial areas in the plane of the slab.

c) Columns -

When in junction with slab, the thickness of slab shall be deducted in computing the column height.

d) Beams -

They shall be measured as clear length between supporting beams and columns. Depth shall be measured clear below slab.

e) Lintels

The length shall be measured including the bearing lengths.

f) Chajja's

Measurement of chajjas shall be inclusive of bearings.

### Rate

The rate includes the cost of material and labour involved in all the operations described above except for the cost of centering and shuttering unless specified. Reinforcement shall be measured separately.

Unless otherwise specified the rates of concrete work shall allow for-

- a. Use of metal 12mm and below in size well-graded in thin members or where reinforcement is crowded,
- b. any shapes and sizes of various members,
- c. all architectural effects like chases, ledges, moulds, grooves, chamfers etc.
- d. provision of any openings, pockets, channels, holes, wooden blocks etc
- e. provision of cover blocks (made out of precast cubes in CM of the same strength as that of concrete of the member or equivalent approved material) to maintain the specified cover to reinforcement
- f. work at all depths and heights and levels and locations
- g. taking out and testing of cubes as per IS specifications
- h. For machine mixing and through vibrating.
- i. The rates for all concrete work shall be for unfinished work only. (It may be noted that all concrete surfaces need not be plastered and all unplastered surfaces are not necessarily form-finished)
- j. Cost towards Design Mix and approval.

## **6.8. Formwork**

Formwork (or shuttering) comprises of all forms and moulds made up of planks and steel sheeting etc., shores, bracings and struts, ties, anchors and hangers, steel rods, bolts and allied inserts, uprights, walling, wedges and all other temporary supports for concrete work during the process of concreting and setting.

### **Material**

Formwork may be of timber, plywood, steel or other metal, plastic or concrete or any suitable material. For special finishes the formwork may be lined with plywood, steel sheets, oil tempered hard board etc. Dented steel plates will not be allowed and shall not be used at all.

Timber shall be easily workable without splitting and shall not warp when exposed to sun or rain or wetted during concreting. Plywood shall be 12 mm. thick complying with IS 4990 and steel shall be 3 mm. black sheets suitably stiffened with angles or appropriate equivalent.

Sliding forms and slip forms may be used for special purpose construction with the approval of the Engineer-In-Charge.

### **Design**

Formwork shall be adequately designed to cater for all the vertical (dead load of wet concrete, superimposed live loads during construction, materials, equipment etc.) and lateral loads without causing displacement, deflection or movement of any kind. The Contractor shall be entirely responsible for the design and stability of formwork regardless of whether he is instructed to furnish the design calculations, drawings and other particulars of his proposal or not, and regardless of whether his proposal has been approved by the Engineer-In-Charge or not. All the expenses arising out of defective shuttering & centering resulting in dismantling / redoing the work etc. shall be to the Contractor's account. For details regarding design, detailing etc. reference may be made to IS 14687. Contractor shall submit formwork design & methodology for the approval of Engineer-In-Charge prior to execution.

### **Erection of Formwork**

Forms shall be true to shape, lines, levels and dimensions of the concrete work as shown on the drawings and shall be rigidly constructed using adequate number of props, struts, ties, braces etc. Where props rest on natural or filled-up ground, the soil shall be thoroughly compacted to avoid any settlement. False-work shall be so constructed that vertical adjustments can be made to compensate the settlements. Wedges may be used at the top or bottom of timber shores, but not at both ends to facilitate vertical adjustments or dismantling of the formwork. No bamboos and wooden bullies shall be permitted to be used for props or cross bearers/bracings.

Proper precautions shall be taken to see that all joints in the formwork are watertight to prevent escape of slurry.

Connections in formwork shall be constructed to permit easy removal of the shuttering and shall be adequately secured by screws, bolts, clamps, wire etc. so as to be strong enough to retain the correct shape during consolidation.

Faces in contact with concrete shall be free from adhering ground, projecting nails, splits or any defects so that when stripped, any formation of blemishes is avoided. All formwork shall be carefully cleaned and thoroughly wetted or treated with an approved chemical compound. Care being taken to keep all reinforcement away from contact from such composition.

Unless specifically permitted, wire ties passing through the walls and through bolts are not permitted. For fixing of formwork, alternative arrangements such as coil nuts shall be adopted at the Contractor's cost.

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 roughed finished shall be planed to remove irregularities or unevenness in the face. Formwork with linings will be permitted.

All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness.

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 the excavation and to ensure the design requirements. No extra payments on this account will be made in any item of work.

Forms shall be so designed and constructed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and 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 resulting concrete surface requires a minimum finish.

### **Bracings, Struts & 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 & other materials. Bamboo's shall not be used as props or cross bracings.

The shuttering / forms for beams and slabs shall be so erected that the shuttering / forms on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Re-propping of beams bottom forms 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.

### **Mould Oil**

Care shall be taken to see that the faces of formwork coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete. Adjoining concrete surfaces shall also be protected against contamination from the coating material.

### **Chamfers and fillets**

All concrete and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and

fillets, unless otherwise specified, shall be 2cm x 2cm. 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.

### **Vertical Construction Joint Chamfered**

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.

### **Wall Ties**

Wire ties passing through the walls shall not be allowed. In their place bolts passing through sleeves shall be used.

### **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 retracted to prevent adhesion, to the satisfaction of Engineer-In-Charge. Warped timber shall be resized.

### **Removal of Forms**

Contractor shall record on the drawing or in a 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 circumstance shall forms be struck until the concrete reaches a strength of 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.

Nor formwork shall be removed or otherwise allowed to move until concrete attains sufficient strength against own weight and external load as per the stipulations of Clause 11.3 of IS 456-2000.

The stripping of formwork shall be done without shock or vibration so that no damage is caused to newly cast concrete. Any damage resulting from premature removal of shutters or from any other cause whatsoever shall be made good by the Contractor at his own expense as directed by the Engineer-In-Charge.

In normal circumstances generally where ambient temperatures are above 15°C and ordinary port land cement is used forms may be struck after expiry of the following periods:

**TABLE - 11**

<b>Type of formwork</b>	<b>Ordinary Portland Cement Concrete</b>
a) Vertical formwork to columns, walls, beams	16-24 hrs
b) Soffit formwork to slabs (Props to be refixed immediately after removal of formwork)	3 days
c) Soffit formwork to beams (Props to be refixed immediately after removal of formwork)	7 days



d) Props to slabs 1) Spanning up to 4.5 m 2) Spanning over 4.5 m	7 days 14 days
e) Props to beams and arches: 1) Spanning up to 6 m 2) Spanning over 6 m	14 days 21 days

For other cements and or lower or higher temperature, the stripping time as above may be suitably modified with prior approval of the Engineer-In-Charge.

### **Oiling of forms**

Use of form / mould oil will not be permitted on the surfaces which require painting.

### **Tolerances**

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

#### **Tolerances for RC buildings**

- Variation from the plumb
  - In the lines and surfaces of columns, piers, walls and in arises 5 mm. per 2.5 m. but not more than 25 mm.
  - For exposed corner columns and other conspicuous lines.

In any bay or 5 m. maximum - 5 mm  
In 10 m. or more - 10 mm

- Variation from the level or from the grades indicated on the drawings –
  - In slab soffits, ceilings, beam soffits and in arises.

In 2.3m - 5 mm  
In any bay or 5 m. maximum - 8 mm  
In 10m or more - 15 mm

- For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.

In any bay or 5 m. maximum - 5 mm  
In 10m or more - 10 mm

- Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.
  - In any bay or 5 m. maximum - 10 mm
  - In 10 m. or more - 20 mm.
- Variation in the sizes and location of sleeves, openings in walls and floors 5 mm. (except in the case of and for anchor bolts).

- Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls **(- 5 mm. + 10 mm.)**
- Footings
  - Variation in dimension in plan **(- 5 mm. + 50 mm.)**
  - Misplacement or eccentricity  
2% of footing width in the direction of misplacement but not more than 50 mm.
  - Reduction in thickness  
5% of specified thickness subject to a maximum of 50 mm.
- Variation in Steps
 

	<u>RISE</u>	<u>TREAD</u>
a) In a flight of stairs	3 mm.	5 mm.
b) In consecutive steps	1.5 mm.	3 mm.

  - i) Tolerances in other concrete structures  
Variation of the constructed linear out line from established position in plan.
 

In 5 m.	10 mm.
In 10 m. or more	15 mm.
  - ii) Variations of dimensions to individual structure features from established positions
 

In 20 mm. or more	25 mm.
In buried construction	50 mm.
  - iii) Variation from plumb, from specified better or from curved surfaces of all structures.
 

In 2.5 m.	10 mm.
In 5 m.	15 mm.
In 10 m. or more	25 mm.
In buried construction	Twice the above
  - 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.	10 mm.
In buried construction	Twice the above
  - v) Variation in cross sectional dimensions of columns, beams buttresses, piers and similar member **(- 5mm + 10 mm)**
  - vi) Variation in the thickness of slabs, walls, arch sections and similar members.
 

**(- 5mm + 10 mm)**

Footings for columns, piers, walls, buttresses and similar members

Variation of dimensions in plan **(-10mm + 50mm)**

Misplacement or eccentricity

2% of footing width in the direction of misplacement but not more than 50mm

Reduction in thickness

5% of specified thickness subject to a max of 50mm

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).

### **Special Provision**

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

Wherever the concreting of narrow members is required to be carried out within shutters of considerable depth, temporary openings (windows) in the sides of the shutters shall, if so directed by the Engineer-In-Charge, be provided to facilitate the pouring and consolidation of the concrete. Small temporary openings shall be provided as necessary at the bottom of shutters of columns, walls and deep beams to permit the expulsion of rubbish etc.

### **Measurement**

a) Unless otherwise stated, shuttering shall be measured as the area of the finished structure which is required to be supported during the deposition of the concrete but no deduction shall be made for holes less than 0.10 Sq.m.

b) Shuttering to secondary beams shall be measured up to the sides of main beams but no deduction shall be made from the shuttering of the main beam where the secondary beam intersects it.

c) Shuttering to beams which intersect with stanchion casings or columns shall be measured up to them on all sides. No deduction shall be made from shuttering to stanchion or column casings at these intersections.

d) Shuttering at construction joint shall not be measured.

e) Shuttering for the cover blocks shall not be paid for separately but is included in the respective items of formwork items.

### **Rate**

The rate of the form work includes the cost of labour and materials required for all the operations described above.

Unless otherwise specified the rate of form work shall allow for-

i) provision of required well supported false work such as staging, access and working platforms for concreting etc.

ii) provision of any dowels and inserts etc. to be left out from shuttering (dowels, inserts etc. themselves shall be paid for under respective items), provision of any holes, pockets, channels etc.

- a) removing the shuttering carefully after specified time limit or as directed.
- iv) work at all depths and heights as specified in the item descriptions.

The formwork generally shall include-

- i) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing etc.
- ii) All supports, struts, braces, wedges as well as mud sills, foundation pads, ground improvement, temporary piles or other suitable arrangements to support the form work.
- iii) Bolts, wire ties, clamps, spreaders, nails or any other to hold the sheathing together.
- iv) Filletting to form stop chamfered edges of splayed external angles not exceeding 20 mm wide to beam, columns and the like.
- v) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.
- vi) Dressing with oil to prevent adhesion and
- vii) Raking or circular cutting.

### **Inspection of forms**

Temporary openings shall be provided at the base of columns and wall forms and other places necessary to facilitate cleaning and inspection. Immediately before concrete is placed all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight, thoroughly cleaned, properly treated and free from foreign material.

When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer-In-Charge shall order all work stopped until the defects have been corrected.

### **6.9. Steel Reinforcement**

#### **Standard**

Steel reinforcing bars shall conform to the following standards –

- |            |                                         |                    |
|------------|-----------------------------------------|--------------------|
| <b>10.</b> | Mild steel & medium tensile steel bars  | - IS: 432 (Part-I) |
| <b>11.</b> | High yield strength deformed steel bars | - IS: 1786         |
| <b>12.</b> | Hard- drawn steel wire fabric           | - IS: 1566         |
| <b>13.</b> | Structural steel, Grade A               | - IS: 2062         |

Binding wire shall conform to IS 280 and shall be soft drawn mild steel wire of size not less than 1.5 mm. in dia. (16 g.)

All reinforcement shall be free from loose mill scales, loose rust and coats of paints, oil, mud or any other substances, which may destroy or reduce bond.

**Supply**

Supply of reinforcement for the Works shall be arranged by the Contractor as per the provisions of the tender.

**Storage**

Reinforcement bars shall be kept in a clean condition out of direct contact with soil, mud, oil, water, etc. They shall be coated with cement wash before stacking to prevent formation of scale and rust. Fabricated reinforcement shall be carefully stored on timber planks / bellies, ends protected, no water shall be allowed to accumulate in the stored area, to prevent damage, distortion, corrosion and deterioration. Storage of materials shall be as described in IS 4082. The areas under storing shall be properly demarcated.

**Fabrication**

Bending of reinforcement shall be in accordance with IS 2502-1963 and as shown in the Drawings and sketches and any written instructions if any. Bars shall not be bent or straightened in a manner injurious to the materials. All bars shall be bent cold except for bars over 25 mm. dia. which may be bent hot if specifically approved by the Engineer-In-Charge. Bars which depend on their strength on cold working shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 645 Degree C) and after bending shall be allowed to cool slowly without quenching.

No reinforcement bar shall be bent when in position without the Engineer-In-Charge's approval, whether or not it is partly embedded in hard concrete. Spiral reinforcement shall have 1½ finishing turns at both top and bottom unless shown otherwise.

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

Cut ends of treated rods shall be given a protective coat of approved zinc paint immediately after cutting.

**Binding**

All bars shall be bound tightly together where they cross, with black annealed steel binding wire. The free ends of the binding wire shall be bent inwards. The binding wire shall satisfy provisions of IS : 280.

**Placing & Fixing**

The reinforcement as per the Drawings and instructions shall be placed, fixed and maintained in the forms within a tolerance of ±10 mm. for effective depth 200 mm. or less and ±15 mm tolerance for effective depth over 200 mm. during the placing and compaction of concrete.

Precast concrete blocks, MS chairs and spacers as required shall be provided to maintain the steel in position. In fair faces of concrete temporary spacers only shall be used and withdrawn as compaction of concrete proceeds.

Tack welding of crossing bars shall be done without any extra cost and only if permitted by the Engineer-In-Charge.

**Cover**

Spacing of reinforcement shall be governed by Clause 25.3 and cover to reinforcement by Clause 25.4 of IS 456-2000. Increased covers, if shown on the drawings or instructed by the Engineer-In-Charge shall be provided at the respective locations. Cover to reinforcement shall be as per IS 456-2000. Fully cured cement mortar blocks of 1:2 mix shall be used as cover blocks where no grade of concrete is specified and where grade of concrete is specified it shall be as per the same strength as that of the structural member. Any other cover blocks shall be used only on approval by the Engineer-In-Charge. However, use of pebbles or stones shall not be permitted. Where the bars cross, the outer one shall have the minimum cover.

**Splicing & Lapping**

Where splicing and / or overlapping in reinforcement are required, the bars shall be provided with such splices or overlaps as are shown on the drawings or directed by the Engineer-In-Charge. Laps shall be staggered only as shown on the drawings and approved by the Engineer-In-Charge.

**Welded Laps**

Butt welding of reinforcing steel bars shall be used only when specified or shown on the drawings or approved by the Engineer-In-Charge. When butt-welding is carried out, the ends of the bars shall be prepared with single 45° C and a backing plate shall be used. The minimum root face will be one quarter of the bar diameter. Welding shall be done in accordance with the recommendations of IS 2751 & 816. Electrodes shall comply with IS 814. The maximum size of electrodes shall be based on following table:

**TABLE - 12**

<b>Diameters of Bars in mm.</b>	<b>Diameters of Bars in inches</b>	<b>Maximum size of Electrodes</b>	<b>Amperage corresponding to maximum size of mm. Electrodes</b>
12 to 25	½" to 1"	10	3.25 mm.
25 to 32	1" to 1 ¼"	8	4.06 mm.
	Double	(0.160)	
32 to 50	1 ¼" to 2"	10	3.25 mm.
	Double	(0.160)	
25 to 50	1" to 2"	6	4.06
		(0.160)	

Before doing the welding of bars at site, the Contractor shall make minimum 3 No. joints and get them tested in an approved laboratory (including X-ray testing of welds if necessary). Only on these tests proving satisfactory, the Contractor would be permitted to weld at site.

The following precautions shall be taken while providing welded laps:

If the cold twisted deformed bar has an untwisted end at the lapping point, the said portion shall be cut off for a minimum length of 10 cm. from such end prior to welding.

Bars shall be aligned on a proper axis to avoid crookedness after welding.

The joints to be welded shall be rust free.

Weld slag shall be chipped off and removed by brush.

## **Welding Contract**

The welding work shall not be given to a sub contractor who does not produce satisfactory evidence of his ability to handle the work in a competent manner. The Contractor shall also prove the ability of the operators employed by him to produce welding connection of the required strength.

The Contractor shall employ a competent welding supervisor or charge-hand to ensure that the standard of workmanship is satisfactory.

The Engineer-In-Charge shall have free access to the work being carried out by the Contractor at all reasonable times and facility shall be provided so that during the course of welding he may be able to inspect any layer of weld metal. Engineer-In-Charge shall be at liberty to reject any work not conforming to the relevant specifications, IS codes . Defective welds shall be cut out and re-welded.

## **Safety requirement and health provisions**

The Contractor shall make all safety and health provisions for his welders as laid in IS : 818 - 1968 i.e. Code of Practice of safety and health requirements in electric and gas welding and cutting operation.

## **Reinforcement to be clean**

All steel reinforcement before the concrete is deposited shall be clean, free of dust, loose scales, oils, rust, grease or any other deleterious materials. Particular care shall be taken to avoid contamination of reinforcement with mould oil.

## **Checking Reinforcement**

No concrete shall be deposited until all formwork and reinforcement have been inspected and approved by the Engineer-In-Charge. There shall be in attendance on each concreting gang a competent steel fixer who shall ensure that the reinforcement and other embedded fittings are kept in position during placing and compaction of concrete.

The Contractor shall provide temporary gangways, platforms and other means of access to prevent men from walking on the reinforcement bats. These shall be independent of the reinforcement.

## **Measurement**

a) Steel reinforcement shall be measured in lengths of different diameters as actually used in the work and their weight calculated on the basis of Bureau of Indian Standard's Structural Engineer's Handbook No. 1 latest issue without any allowance for rolling margin. All authorised spacer bars on supports on any saddles, forks, chairs, laps, etc. shall be measured on the actual quantity consumed in the job.

b) Wastage and unauthorised laps etc. shall not be measured for payment purpose.

c) Annealed steel wire required for binding or tack welding shall not be measured, its cost being included in the rate of reinforcement.

d) Wherever lap joints are provided by welding, the measurement shall be on linear meter of the actually welded seam length.

## Rate

The rate for reinforcement shall include the cost of labour and materials required for all the operations described above such as cleaning of reinforcement bars, straightening, cutting, hooking, bending, binding, placing in position etc. as required or as directed including tack welding on crossing of bars in lieu of binding with wires, wastages etc.

### 6.10. Ready Mix Concrete

General specifications shall be as described under- Reinforced cement concrete specifications & shall generally comply with the requirements of IS : 456 - 2000.

Ready mixed concrete is the concrete delivered at site from a Central Plant. The delivery is made by either agitator truck or truck mixer in a plastic condition requiring no further treatment before being placed in position in which it is to set and harden. The ready mix concrete shall conform to IS 4926, Specification for Ready Mixed Concrete is subject to the following:

- The ready mixed concrete shall be Centrally Mixed Concrete unless otherwise specifically mentioned.
- Batching plant : The batching plant shall be of fully automatic central batching and mixing type conforming to the provisions of IS : 4925. The capacity of the plant shall not be less than 30 cu.m./ hour.
- The ready mixed concrete shall be manufactured strictly as per the approved mix design by Engineer-In-Charge and supplied on the basis of specified strength based on 28 day compressive strength of 15 cm cube tested in accordance with IS : 456 - 2000. For any change in quality / quantity in the ingredients of a particular concrete for which mix has been designed earlier and approved by the Engineer-In-Charge, the mix has to be redesigned and accordingly approval shall be obtained prior to use.
- Since the ready mixed concrete is a tailor made concrete, certain precautions are necessary for the concrete mix. Some of these are as listed below :
- Minimum quantity of cement and the details regarding proportioning and works control shall be in accordance with IS : 456-2000.
- The air content of the concrete shall not be more than 2% in any case. This shall be established by necessary testing at worksite.
- The dosage of the admixture shall be given at the batching plant only. Subsequent dosage of admixture shall not be permitted thereafter unless otherwise permitted by the Engineer-In-Charge.

Water shall not be added to ready-mixed concrete to restore the workability of concrete. However the workability can be restored to the design slump by use of proper admixture (without retarding effect) with prior approval of the Engineer-In-Charge provided the slump has not dropped below 50 mm. For the concrete with slump less than 50 mm and more than zero mm, the slump shall not be revised after the initial setting of the concrete. The initial setting of the concrete shall be established at worksite by the procedure in accordance with IS: 8412 -Method of test for determining setting time of concrete by penetration resistance.

When a truck mixer or agitator truck is used for transporting concrete, the concrete shall be delivered to the site for work the exact location as approved by the Engineer-In-Charge.



Discharge of the concrete to be done by chute only to avoid segregation. The slump shall be checked at this delivery point. Further transport and placing of concrete along with compaction shall be completed prior to initial setting of concrete. In any case total transport time not to exceed 1½ hours.

**Placing of Concrete:**

When placing of concrete by manually the following shall apply –

Method of placing of concrete shall be such that no segregation occurs during placing. In manual placing, contractor has to arrange proper paths for the free movement of wheel barrows. Contractor has to prepare method statement for placing operation and get the same approved from Engineer-in-charge prior to actual execution. Generally concrete shall not be dropped freely from a height of more than 1.5 meters in the works of watertight structures and 2 m. in all other works. When required to be deposited from a greater height, it shall be done through a metal-lined chute with slope no flatter than 1:2 (Vertical : Horizontal) and not steeper than 1:3. The discharge end of the chute will be provided with a baffle plate to prevent segregation. The discharge end of the chute shall be maintained above the surface of the concrete in forms and concrete shall not be permitted to fall from the end of chute by more than 1 m. During cleaning a chute, the waste water shall be kept clear of the forms.

**When placing concrete by mechanical equipment, the following shall apply**

Central-bottom-dump buckets which provide for positive regulation of the amount and rate of deposition of concrete in all dumping position shall be employed. Concrete shall be discharged by a vertical drop into the middle of bucket or hopper. 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 shall be opened slowly to avoid high vertical bounce. The height of drop of concrete shall not exceed 1 m. Dumping in a manner which would result in segregation of concrete ingredients shall not be permitted.

**If pumps & pneumatic placers are used for conveying and placing concrete**

Concrete mix with desired slump shall be appropriately designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping is started. Care shall be taken to minimize frictional losses.

Before commencing to pump concrete, the pipeline shall be “Lubricated” with two batches of 1:2 cement and sand mortar. If required, sponge balls to be placed in pipes before grouting. Adequate emergency for washing / cleaning of pumps and pipelines to be made for efficient working. Supports to the pipes should be firmly ensured.

Manufacturers’ instructions regarding pipeline layout, concrete quantity etc. shall be taken to avoid problems as blockages and excessive wear etc.

Pipe dia to be adequate and minimum pipe dia. to be three times the maximum aggregate size of the concrete mix. The pipe should be as far as possible rigid to avoid increased frictional losses and cleaning problems. Aluminium pipes shall not be used under any circumstances.

Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 cm to 90 cm such that the formation of cold joints, of planes of weaknesses between each succeeding layer within the pour are avoided. The bucket loads or other units of deposit shall be 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.

Freshly laid concrete shall not be wheeled over or walked over or otherwise disturbed.

When depositing concrete adjacent to a construction joint, special care shall be taken not to disturb the dowels or other reinforcing bars projecting from the existing concrete.

In vertical members like walls, columns, piers etc. where the full height is not being poured in one continuous operation, the surface of each lift shall be finished horizontal and any laitance removed between the period of initial and final set.

### **Admixtures**

Contractor shall submit the following before any admixture is approved by the Engineer-In-Charge for their use –

- Certificate conforming that the use of a particular brand of admixture shall not be harmful to concrete in any way.
- Certificate conforming the exact dosage of admixture of a particular brand
- Certificate stating the specific purpose for which the admixture is to be used.
- Special precautionary measures to be taken in the manufacture of concrete when using the particular brand of admixture.
- Certificate conforming that the admixture conforms to specifications of IS 9103 or to ASTM – C 260, ASTM – C 10, ASTM – C 595 or to ASTM-C 618.

Engineer-In-Charge at his discretion may require tests to be performed to reconfirm the characteristic properties of any admixture. All such tests shall be done in accordance with IS 9103.

All tests described above shall be done at the site laboratory or at a laboratory to be identified by the Engineer-In-Charge depending on the test to be conducted.

All test shall be done in the presence of a representative nominated by the Engineer-In-Charge and a representative of the concrete manufacturer / Contractor when tests are performed at the site laboratory. All observations and reports of test shall be jointly signed by the two representatives before the test results are submitted to the Engineer-In-Charge for approval.

Expenses for all materials used for testing, sampling procedures and testing including preparing reports shall be borne by the Contractor.

### **Sampling & testing for quality control of concrete**

#### **Fresh concrete**

Fresh concrete shall be tested for

- Slump
- Compacting factor/workability
- Consistency
- Weight per cubic metre, cement factor and air content.

#### **Slump**

For concrete totally mixed in a central plant, slump shall be checked at

- immediately during loading of trucks

- Point of discharge from the delivery truck
- Final placement location

At placement location the slump measured shall conform to the design slump. Manufacturer of concrete shall adjust for loss of slump in transit and establish the requirements of design mix. All slump measurements shall be done within a period of 20 minutes from the time cement is added to the mixer. Placement contractor shall transport concrete from truck discharge point to actual placement location within 10 minutes of delivery before the final slump reading is taken at placement location.

For concrete entirely mixed in transit or for shrink mix concrete, slump readings shall be taken at

- point of discharge from delivery trucks
- final placement location

For measuring concrete slump at point of discharge from delivery trucks, samples shall be taken from concrete omitting the first and the last 15 % of the load. For concrete delivery or placed by pumping, sampling shall be similar to those specified for delivery trucks.

Slump measurement of ready mix concrete transported by buckets shall be at locations specified in above para with some limits of time. Sampling from buckets shall be such that the buckets containing discharge from mixer for the and last 15% are omitted.

At placement locations, samples for checking slump shall be collected from every 20 cum of concrete or part thereof placed at location for each type of concrete.

For all slump checks in the field at least two recordings shall be made and the average value taken as the recorded slump.

Slump checks for concrete in the laboratory shall be carried out as and when required by the manufacturer of concrete during the mix design stage and during the progress of work for control on field results.

Slump readings shall only be a guideline for concrete consistency and shall not be taken as the acceptability criteria for concrete placed at location. All slump tests shall be carried out in accordance with IS : 1199.

For quality control of strict check on the strength of concrete shall be maintained along with other field requirements such as workability, consistency, slump etc. mentioned in para above.

Acceptability criterion for concrete as specified in para above shall only be applicable.

Test on cube crushing strength of concrete in accordance and compliance with IS 456-2000 and IS 516 shall be done as under –

- o Samples of fresh concrete shall be taken from concrete at central batch plant mixer while loading delivery trucks or other transport and also from concrete transported to placement location.
- o Test on specimens made from samples collected at placement location shall be considered as field test specimens and results therefrom shall be the criterion of concrete strength. Test in specimens made from samples at the batch plant shall only be taken as guide lines test. Only in the case of doubtful result, the Engineer-In-Charge may refer to such guide line results for deciding on the quality of concrete

- For truck mix concrete and shrunk mix concrete guide line test specimens shall be made from samples collected at discharge location from mixing trucks. For this purpose first and last 15% of the load shall be omitted while collecting samples.

The contractor shall set up a laboratory at this own expense which shall have facilities for conducting all necessary field test on materials and field and laboratory test on concrete. The laboratory shall be staffed with qualified and experienced

## 7. BRICKWORK

### **Materials**

Bricks used for masonry work shall conform to IS 1077 except that sizes shall be as per the approved local bricks. The crushing strength shall be as specified in IS 3495.

Bricks shall be of uniform size shape and colour. They shall be well burnt and free from cracks, twists, stones, floats or nodules of lime and other defects. They shall have sharp and square edges and parallel faces, sound texture, uniform colour and they shall give a ringing sound when struck with a mallet. No brick shall absorb on average water more than 20% of its dry weight in 24 hours.

Brick shall be procured from source/s to be approved by the Engineer-In-Charge.

It shall not break when struck against each other and dropped flat from a height of one meter on ground.

Mortar- The mortar for the work shall be as specified under - Mortars specifications.

### **Laying**

All the masonry work shall be carried out to specified dimension, lines and levels indicated on the drawings or as directed by the Engineer-In-Charge and a good bond shall be provided throughout the work both longitudinally and transversely.

Double scaffolding of adequate strength shall be provided for all types of loads likely to come on them during construction. No holes allowed in masonry for scaffolding.

During rains and frosty weather, the work shall be carefully covered so as to prevent any mortar being washed away.

Any anchors, wall plugs, accessories, flashings and other items required to be built in with masonry shall be provided in their correct position as the masonry work progresses.

Before new work is started, all loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

### **Brick Work Proper**

Every brick shall be thoroughly soaked in water before using in work. Before starting the brick masonry the concrete surfaces e.g. plinth beams, columns, slabs, chajjas, lofts etc. shall be thoroughly hacked and washed to remove all mud, dirt, loose particles etc. and a thin coat of cement slurry shall be applied over concrete surfaces when fresh masonry is to be started on or against old masonry, the surface of the old masonry shall be thoroughly cleaned and washed to remove all moss deposits loose mortar mud and dirt etc.

Brickwork shall be laid in English Bond with frog upwards unless otherwise specified. In exposed brickwork, selected bricks of the specified class shall be used for the face work. No half or quarter brick shall be used except as closures. Nor more than ten courses shall be raised in a day and no part of the work shall be raised more than 1 m. above another at any time.

The size of the brick shall be 22.5 x 11.5 x 7.5 cm. unless otherwise specified; but tolerance up to  $\pm 3$ mm. in each direction shall be permitted, however, bricks conforming in size to IS

1077 could be used. Bricks shall be provided with frogs. Only full size bricks shall be used for masonry work. Brick bats shall be used only with permission of the Engineer-In-Charge to make up required wall length or for bonding. Sample bricks shall be submitted to the Engineer-In-Charge for approval and brick supplied shall confirm to approved samples. If demanded by Engineer-In-Charge, brick sample shall be tested as per IS 3495 by the Contractor at no extra cost to Employer. Brick rejected by Engineer-In-Charge shall be removed from the site of works within 24 hours.

Each brick shall be set with both bed and vertical joints filled with mortar as per IS 2250. Joints shall not be less than 6 mm. and not more than 10 mm. in thickness and are to be full of mortar, close, well finished and neatly struck. All joints shall be adjusted to their final position in the wall while the mortar is still soft and plastic. All joints shall be raked out by raking tools when mortar is still green to a depth of 12 mm. to ensure good key to plaster or pointing. Where plastering or pointing is not required to be done, the joints shall be uniform in thickness, struck flush and finished at the time of laying.

The face of brick work shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If the mortar in the lower course has begun to set, the joints shall be raked out to a depth of 12 mm. before another course is laid.

Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural steel, steel lintels etc. shall be installed by the Contractor. Openings etc. shall be provided as shown on the drawings. Chases, pockets etc. shall be provided as shown on the drawing to receive windows, louvers, doorframes, circular openings for exhaust fans etc.

Curing shall constantly keep the brick masonry moist on all faces for a minimum period of seven days. Brickwork done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on curing period.

## 7.1. Half Brick Work

### **Material**

Bricks and mortar shall be as specified under -Brick work specifications.

The reinforcement used for the half brick work shall be as specified under- Reinforced Cement Concrete specifications. All steel reinforcement before the concrete for RC stiffeners / patli is deposited shall be clean, free from dust, loose scales, oils, rust, grease or any other deleterious materials. Particular care shall be taken to avoid contamination of reinforcement with mould oil.

Cement concrete – The cement concrete work for RC stiffeners/ patli of specified grade shall be as specified under - Reinforced Cement Concrete specifications.

Laying- Generally shall be laid in the same manner as described under- Brick work specifications.

Half-brick work shall be carried out in panels and with horizontal stiffeners of 75 mm. thick unless otherwise specified 900mm at vertical intervals, with MS 2 No. 6mm. dia. Reinforcements laid in 1:2:4 nominal mix concrete properly filled as per specifications. These shall be securely anchored at their end where the partitions end. The free ends of the reinforced shall be keyed into the mortar of the main brick work to which the half brick work is joined. The mortar used for reinforced brick work shall be rich dense cement mortar of mix 1:4 .Over laps in reinforcement, if any shall not be less than 30cm The mortar interposed

between the reinforcement bars and bricks shall not be less than 5mm. The mortar covering in the direction of joints shall not be less than 15mm

**Measurement**

The length and height of the wall shall be measured correct to a cm. The area shall be calculated in sq.m where half brick wall is joined to the main walls one brick greater thickness and measurements for half brick wall shall be taken for its clear length from the face of the thicker wall.

In case of half brick masonry with RC stiffeners / patlis etc., stiffeners including reinforcement, shuttering etc. shall not be measured for separately.

Deductions shall be as described under –Brick work specifications.

**Rate**

The rate includes the cost of the materials & labour involved in all the operations described above including RC stiffeners & reinforcement, double scaffolding, curing etc.

## **8. MARBLE/ GRANITE STONE WORKS**

### **8.1. Materials**

Marble slabs / Granite slabs shall be of the best quality and in sizes and thickness as approved by the Engineer-In-Charge. The specified thickness shall be taken at the thinnest part.

They shall be hard, dense, uniform and homogenous in texture having clean crystallizing grain and free from all defects and cracks. The edges shall be machine cut true and square and surface shall be machine polished to an even and perfectly plain surface.

Marble slabs shall confirm to IS 1130 – 1969.  
Granite slabs shall confirm to IS 3316 – 1974.

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

Stones to be used for skirting and dado shall be from the same stock and shade as used for floors. Tolerance in thickness of stone shall be  $\pm 3$  mm.

### **8.2. Marble / Granite Stone work in steps / platforms / frames etc.**

#### **Materials**

Material and general specifications shall be as described under -granite/ Marble flooring specifications except joint shall be permitted only at curvature or when width / length is more than 0.6 / 2 metres respectively. No of joints in each direction shall not be more than one for every 2 metres. Additional joints shall be provided as shown in the drawing subject to approval of Engineer-In-Charge. Finishing/ polishing if not possible with machine can be done by standard practices, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

### **8.3. Cudappa/ Granite/ Marble stone window framing**

#### **Materials**

Cudappa/Granite/ Marble stones / strips shall be of the best quality, sizes and thickness as specified and approved by the Engineer-In-Charge. The specified thickness shall be taken at the thinnest part. General specifications shall be as described under -Flooring specifications.

As sample of window framing shall be prepared and it shall be kept on worksite after being approved by the Engineer-In-Charge.

#### **Mortar**

The mortar used for jointing shall be as described under -Marble/ Granite Flooring specifications.

#### **Laying**

The stone shall be wetted before laying. The framing (about 200mm wide) shall be made by using 2 No. strips of suitable size stuck together with adhesive chemical to form a rebate of



minimum 100mm for sliding and openable windows while one strip for Fixed ventilators/ Louvered windows. Laying / fixing of window framing shall be as described under - Marbles/ Granite flooring specifications. In case spans are more, where so desired the stones shall be secured to each other by means of copper pins 75mm long and 6mm diameter or as specified or as directed.

### **Joints**

All joints shall be full of mortar. If any hollow groundings are detected by tapping the face stones, these shall be taken out and re-laid. No joints in between are permitted unless otherwise specifically approved by the Engineer-In-Charge the framing stone shall be in single piece. The thickness of the face joints shall be uniform, straight and as fine as possible, not more than 1.5mm in the face joint the top 6mm depth shall be filled with mortar.

### **Curing**

The work shall be kept constantly moist on all faces for a period of at least seven days.

### **Finishing**

Finishing shall be as described in the item description. Unless other wise exposed edges to be rounded off / chamfered and polished as specified or directed. When factory made finished slabs are used, no further polishing is required.

### **Protection and scaffolding**

Double scaffolding having two sets of vertical supports shall be provided where necessary. The supports shall be sound and strong, tied together by horizontal pieces over which the scaffolding plank shall be fixed. Green work shall be protected from rain by suitable coverings. The work shall also be suitably protected from damage during construction.

## **9. WOOD WORK**

### **9.1. Scope**

This section shall cover all woodwork, joinery and similar work in the Building. All wood work associated with work of all other sections shall also be done generally according to these specifications unless specified otherwise. Unless otherwise specified, Timber used in the work shall be approved quality.

### **9.2. General**

No woodwork shall be painted, varnished waxed or otherwise finished before specifically approved by the Engineer-In-Charge.

### **9.3. Fixing Generally**

All wood shall be fixed in the manner as shown in the drawings. If not shown, fixing with masonry or concrete shall be done with expansion plugs and screws of approved size, under no circumstances they shall be fixed by wooden plugs.

### **9.4. Workmanship**

All work shall be done in workmanlike manner as per best trade practices by skilled workmen.

### **9.5. Starting of Work**

Unless otherwise instructed, finishing of woodwork on trims, finished frames, etc. shall not be commenced until all interior plastering and flooring is completed and cured and area cleared of all rubbish. Whenever so required samples of actual work shall be installed at the site and got approved by the Engineer-In-Charge.

### **9.6. Timber**

All wood shall be of best quality kiln seasoned timber of its kind specified. Unless otherwise stated all wood shall be approved CP teak wood. All timber shall be treated with approved anti-termite treatment. All wood in contact with masonry or concrete shall be painted with hot bitumen before placing in position taking care to ensure that exposed parts of the timber are completely free from any bitumen. Samples of all wood shall be got approved before ordering. Moisture content of wood shall be in accordance to IS:287-1993. CP Teak wood shall not possess any individual hard and sound knot exceeding 40 mm in diameter and the aggregate area of all the knots shall not exceed one percent of the area of the piece.

### **9.7. Sawing**

All scantlings, planks, battens, etc. shall be sawn in straight lines, planes, uniform thickness, of full measurements from end to end and shall be sawn in the direction of grain. They shall be procured with sufficient margins in as to secure the specified dimensions, lines and planes after being wrought.

### **9.8. FLUSH DOOR SHUTTERS**

**9.8.1.** Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 35 mm. Thickness and type of shutters shall be as specified.

**9.8.2.** Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer in-Charge. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

#### **9.8.3. Core**

The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lapping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

#### **9.8.4. Face Panel**

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers, as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

#### **9.8.5. Lipping**

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

#### **9.8.6. Rebating**

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

#### **9.8.7. Opening for Glazing**

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of

width not less than 25 mm. Opening for glazing shall be provided where specified or shown in the drawing.

#### **9.8.8. Tolerance**

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

#### **9.8.9. Adhesive**

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

#### **9.8.10. Tests**

Samples of flush door shutters shall be subjected to the following tests, if directed by Engineer – In- Charge:

- (a) End Immersion Test
- (b) Knife Test
- (c) Glue Adhesion Test

#### **9.8.11. Fixing**

This shall be as specified in CPWD Specifications.

#### **9.8.12. Measurements**

Length and width of the shutters shall be measured to the nearest cm in closed position covering the rebates of the frames but excluding the gap between the shutter and the frame. Overlap of two shutters shall not be measured.

All work shall be measured net as fixed and area calculated in square metres to nearest two places of decimal. No deduction shall be made for providing venetian opening and opening for glazing.

#### **9.8.13. Rates**

The rate includes the cost of material and labour involved in all the operations described above. Extra rate shall be payable for providing rebates in double leaved shutters. Glazing when provided shall be measured & paid for separately as specified in BOQ.

### **9.9. FITTINGS**

**9.9.1.** Fitting shall be of brass, aluminium or as specified. Screw holes shall be counter sunk to suit the head of specified wood screws. These shall be of the following types according to the material used.

- (a) Brass Fittings: These shall be finished bright satin finish or nickel chromium plated or copper oxidised or as specified.
- (b) Aluminium Fittings: These shall be anodised to natural matt finish or dyed anodic coating not less than grade AC 10 of IS 1868.

The fittings generally used for different type of doors and windows are indicated in CPWD specifications. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of the same metal, and finish as the fittings. However, chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings. These shall be of the size as indicated in CPWD specifications or directed by Engineer-In-Charge.

Fittings shall be fixed in proper position as shown in the drawings or 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 screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sinking of hinges.

#### 9.9.2. Butt Hinges

These shall be of the following types according to the material used.

- (a) Mild steel butt hinges (Medium).
- (b) Cast brass butt hinges light ordinary or heavy.
- (c) Extruded aluminium alloy butt hinges.

9.9.2.1. Mild Steel (Medium): These shall be medium type manufactured from M.S. sheet. These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS 1341.

- 2 Hinge Pin: Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and rivetted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.
- 3 Knuckles: The number of knuckles in the hinges of different sizes shall be as per IS 1341. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.
- 4 Screw Holes: The screw holes shall be clean and counter sunk. These shall be suitable for counter sunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of the wood screws. The nos. of screw holes shall as specified in IS 1341.

- 9.9.2.2. Cast Brass: These shall be light ordinary or heavy as specified. These shall be well made and shall be free from flaws and defects of all kinds. These shall be finished bright or chromium plated or oxidised or as specified. These shall generally conform to IS 205.
- 5 Hinge Pin: Hinge pin shall be made of brass or of stainless steel. The hinge pins shall be firmly rivetted and shall be properly finished. The movement of the hinge pin shall be free, easy and square and shall not have any play or shake.
  - 6 Knuckles: The number of knuckles in each hinge shall not be less than five. The number of knuckles in case of sizes less than 40 mm shall be three. The sides of the knuckles shall be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.
  - 7 Screw Holes: The screw holes shall be clean and counter sunk and of the specified size for different types and size of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

9.9.2.3. Extruded Aluminium Alloy: These shall be manufactured from 1M extruded sections. These shall be well made and free from flaws and defects of all kinds. These shall generally conform to IS 205.

- 8 Hinge Pin: Hinge pin shall be made of mild steel (galvanised or aluminium alloy). The aluminium alloy hinge pin shall be anodised. The hinge pin shall be finally rivetted and shall be properly finished. The movement of hinges shall be free easy and square and shall not have any play or shake.
- 9 Knuckles: Number of knuckles in. each hinge pin shall not be less than 5. The number of knuckles in case of sizes less than 40 mm be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.
- 10 Screw Holes: The screw holes shall be suitable for counter sunk head wood screws, and of specified sizes for different type of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

**11 Note: Any hinge which fails to satisfy the requirements of anyone or more of the characteristics shall be considered as defective hinge.**

9.9.2.4. **Aluminium Sliding Door Bolts:** These shall be made of aluminium alloy and shall generally conform to IS 2681. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door, when iron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot be fixed, hole of suitable size shall be drilled in the door frame and an iron or brass ~ plate cut to shape shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts shall be as per CPWD Specification.

### 9.9.3. Tower Bolts

9.9.3.1. These shall generally conform to IS 204 (Part. I) & IS 204 (Part. II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit

counter sunk head of wood screws. All sharp edges and corners shall be removed and finished smooth.

- 12 The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 metre.
- 13 (a) Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloy. The knob shall be properly screwed to the bolt and rivetted at the back.
- 14** The plates and straps after assembly shall be firmly rivetted or spot welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

#### **9.10. Door Latch and Handles**

- 9.10.1.** This shall be as specified and shall be capable of smooth sliding action. The size of door latch shall be taken as the length of the latch.

#### **9.11. Universal Hydraulic Door Closer (Exposed Type)**

- 9.11.1.** These shall be made of aluminium alloy and of shape and pattern as approved by the Engineer-in-Charge.
- 9.11.2.** These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564.
- 9.11.3.** Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements.

#### **9.11.4. Glass Panes**

Glass panes shall weigh at least 13.5 kg/m<sup>2</sup> and shall be free from flaws, specks or bubbles. All panes shall have properly squared corners and straight edges.

## **10. FINISHING WORKS**

### **10.1. Cement Plastering, Scaffolding, Finishing, Precaution and Curing**

Cement plaster shall be of 6, 12, or 20 mm thick as specified in the respective item.

#### **Materials**

Cement mortar shall be as described under- Mortar specifications. However, cement used in the plaster shall be Portland Pozzolana Cement (PPC) Fly ash based conforming to IS: 1489 (Part-I.) unless other wise specified. Only river washed sand shall be used. Pan type mixer for mortar should preferably be used.

#### **Application**

Unless otherwise specified all plaster work shall be carried out in accordance with IS 1661.

The thickness and proportion of cement mortar shall be as specified or directed.

Unless permitted otherwise by the Engineer-In-Charge, only double scaffolding of adequate strength shall be provided by the Contractor. No holes shall be made in the masonry for supporting the scaffolding. Scaffolding members shall not be tied to windows, doors, other members provided in the walls.

No plastering work shall commence until the surface preparatory work is approved by the Engineer-In-Charge.

The sand shall be as approved by Engineer-In-Charge and in accordance with IS 1542 specification for plaster.

#### **Preparation of Surface**

Joints of all masonry work shall be carefully raked out for a depth of about 12 mm. without causing any damage to the masonry. Surfaces of concrete work shall be thoroughly roughened with chisel by pricks prior to application of plaster. For materials, which are not able to receive plaster directly, the necessary procedures shall be carried out as per the directions of the Engineer-In-Charge

All surfaces shall be thoroughly cleaned of all dirt, soot, oil, grease and any other material preventing proper bonding etc. and any efflorescence shall be removed by brushing and scraping. The surface shall then be soaked with water for at-least 6 hours prior to application of plaster to ensure proper adhesion between the surface and plaster. If any surfaces become dry in spots, such area shall be moistened again to restore uniform suction.

#### **Procedures / Precautions Applicable to Workmanship**

Plaster work shall proceed from top to bottom in one operation on an entirely unobstructed surface or on areas up to break against openings.

Long straight edge shall be used to ensure perfectly even surface. All corners, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. All soffits, exposed angles with door and window frames shall be carefully finished. Internal angles shall be rounded if so directed and arises shall be rounded, splayed or beaded as directed. The mortar shall adhere to the surface intimately when set and there should be no hollow sound when struck.



All plaster work shall be kept cured for a minimum period of 10 days after the application of finishing coat to prevent excessive evaporation. Matting of gunny bags should be hung over the outside of the plaster in a hot dry weather.

### **1<sup>st</sup> Coat**

The thickness shall be about 12 mm. thick in case of brick walls, RC walls and columns and 6 mm. thick for ceiling, soffit of beams etc. Before this coat hardens, the surface shall be cross scratched to provide a mechanical key for the 1<sup>st</sup> coat. The cross-scratch shall be horizontal as far as possible to aid curing which will be done for at least 2 days immediately following the application.

### **Finish Coat**

At least a period of 3 days should elapse between the application of the first coat and the finish coat.

### **Curing**

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered.

The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expenses by such means as the Engineer-In-Charge may approve. The Dates on which the plastering is done shall be legibly marked on the various sections so that for the specified period it can be watched.

### **Measurement**

For plastering, the measurement shall be on area superficial for the unfinished surfaces as actually covered. Length and breadth shall be measured correct to a cm and its area shall be calculated in Sq.m. correct to two places of decimal. Dimensions before plastering shall be taken.

The areas shall include (all the actual pointed / plastered areas for jambs, sills, soffits of openings etc.

No deductions shall be made for ends of joints, beams etc.

No extra shall be allowed for beaded, chamfered or rounded arrises or curved angles.

### **Rate**

The rate shall include the cost of all labour and materials involved in all the operations described above excluding chicken mesh, which shall be measured separately.

### **Measurement**

Included in plastering work wherever specified.

### **Rates**

Included in plastering work wherever specified.

## **10.2. Plaster of Paris Finishing (POP):**

### **Material**

The Plaster of Paris shall be of calcium-sulphate semi-hydrate variety. Its fineness shall be such that when sieved through a sieve of IS sieve designation 3.35 mm for 5 minutes after drying the residue left on it shall not be more than by 1% by weight. It shall not be too quick setting. Initial setting time shall not be less than 13 minutes. The average compressive strength of material determined by testing 5 cm cubes after removal from moulds, after 24 hours and drying in an oven at 40° C till weight of the cubes is constant & shall not be less than 84 kg per square metre.

### **Application**

The 'POP' as prepared above shall be applied to the prepared surface with a steel trowel to a thickness not exceeding 6mm and rubbed and polished to a perfectly smooth and even finish working from top to bottom. While towelling is going on soap stone powder contained in thin muslin bags shall be dusted over the surface and worked in.

The surface of the under coat on which the punning is to be done shall be left rough. The punning shall be applied, when the under coat is still green. The mortar for punning shall be applied in a uniform layer slightly more than 6mm thick between gauged pads, with which to ensure an even and uniformly thick surface by frequent checking with a wooden straight edge. It shall be finished to an even and smooth surface with trowels.

All corners, arrises, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. Rounding or chamfering corners, arrises, junctions etc. where required, shall be punned without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the size required. No portion of the surface shall be left out initially to be patched up later on.

### **Thickness**

The thickness of the finished punning shall not be less than 6mm thick, unless specified.

### **Scaffolding, Finishing, Precaution and Curing**

Specifications for these shall be as described under- Plaster specifications.

## **10.3. Sand Faced Cement Plaster:**

### **General**

This shall be done in two coats. Backing coat shall be 12 mm. thick in 1:4 cement mortar with 2% by weight of cement of approved integral cement waterproofing admixture added to it, unless specified. The second and finishing coat shall be 8 mm. thick in 1:3 CM, unless specified.

### **Materials**

Cement mortar shall be as described under- Mortar specifications. However, cement used in the plaster shall be Portland Pozzolana Cement (Fly ash based) conforming to IS: 1489 (Part - I) unless other wise specified Only river washed sand shall be used. Pan type mixer for mortar shall preferably be used.

Integral waterproofing compound conforming to IS: 2645 and of approved brand and manufactured, enlisted by the Engineer-In-Charge from time to time shall be used. The Contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement that does not run out separately when water is added.

Chicken wire mesh 22 gauge at junction of RCC and masonry work 150 mm. (at 6") overlap on either side shall be fixed with nails. *(Chicken wire Shall be measured separately under relevant item)*

### **Application**

This shall be applied in 2 coats. The first coat or the base coat shall be approximately 12 mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows etc. The base coat shall be splashed on to the prepared surface with heavy pressures, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The base coat shall be cured for at least seven days.

For backing coat about 15 cm. x 15 cm. plaster patches shall be prepared as gauges at convenient distance apart to ensure even plastering in one plane. The mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joint and on the surface by wooden floats to produce an even and uniform surface. The surface shall be roughened with wire brushes to give a good bond to the finishing coat. The backing coat shall be cured for 4-5 day.

For the finishing coat, sand used shall be screened to pass through 3 mm. mesh sieve (all material passing through 1.5 mm. mesh sieve shall be eliminated). The coat shall be applied uniformly with wooden float and the entire surface shall be rubbed with approved sponges (e.g. wooden float lined with cork) to expose the sand grains uniformly and predominantly, while finishing steel trowel shall not be used and overworking shall be avoided.

### **Measurement**

Measurement shall be as described under- Plastering specifications.

### **Rate**

The rate shall include the cost of all labour and materials involved in all the operations described above including integral waterproofing compound but excluding chicken mesh which shall be measured separately.

## **10.4. Waterproof Cement Plaster:**

### **Materials**

Cement mortar shall be as described under – Sand faced plaster specifications.

### **Application**

Application shall be as described under- Sand faced plaster specifications.

**Finish coat**

When the plaster has been brought to a true surface with wooden straight edge it shall be uniformly treated over its entire area with paste of neat cement and rubbed smooth, so that the whole for surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sq. m. Smooth finishing shall be completed with trowel immediately and in no, case later than half an hour of adding water to plaster mix.

The first coat shall be evenly dampened and 5 mm thick finish coat shall be well smooth after floating it with a coat of Portland Cement. The use of dry cement shall not be permitted.

Integral waterproofing compound conforming to IS: 2645 and of approved brand and manufactured, enlisted by the Engineer-In-Charge from time to time shall be used. Applications shall be as described under sand faced plaster specifications.

**10.5. Grooves in Plaster:****Materials/mortars**

Materials /mortar shall be as described under Plastering specifications.

**Application**

The horizontal and vertical grooves shall be exactly to the required depth and width as shown in the drawings and shall be in perfect lines without any break in continuity. The grooves shall be neatly finished with extreme case.

Plasterwork shall follow following steps and work shall commence only after approval of the Engineer-In-Charge. .

3. Surface shall be properly cleaned.
4. Plaster area shall be provided with level pads or spots allowing working & checking with 2 - 3m. straight edge. Depth of plaster shall not be less than 8mm. at any point.
5. Required concealing services work shall be completed and tested prior to start of plasterwork.
6. No further cutting of masonry shall be allowed.
7. Repairs carried out to masonry or concealing work shall be cured and dry.
8. Surface shall be sufficiently damp / wet.
9. Plaster pads shall be checked for plumb & level and approved by Engineer-In-Charge.

Corners, external or internal shall be finished along with finished coat. It is advisable to have rounded corners.

Plaster shall be cured for 14 days by wet curing except in neeru finish plaster.

Plaster shall be levelled and lined by Aluminium hollow section of 2-3 m. long. (This will give even and levelled surface). There shall not be more than 2 mm. difference in level when checked with 3 m. straight edge. It is important enough pressing and beating is done to achieve compact filling of joints and area shall be fully compacted.

Finishing of plaster may be carried out with wooden float (randhaas) or trowelled smooth with sheet metal trowels as specified. Care shall be taken to avoid excessive trowelling and overworking the wooden float.

All corners, internal or external, shall be truly vertical or horizontal. These shall be finished with a proper template to achieve best workmanship for rounding and chamfering as specified or directed.

Plaster shall be cut to correct horizontal or vertical line at the end of the day or if work required to be suspended for any reason.

Area of plaster is advisable to be limited to 15 Sq.m. To avoid cracks due to thermal movements of dissimilar material in contact, it is advisable to provide joints, treated with groove or any other detail suggested by the Engineer-In-Charge. These joints if not specified shall be treated with 100 mm. wide reinforcing chicken mesh fixed over joints by G.I. nails and area plastered.

#### **10.6. White / Colour Washing:**

##### **Materials**

The materials for preparing lime wash shall be freshly burnt fat lime of good quality free from unburnt stone or other foreign matter. Lime shall be of "C" type as mentioned in IS 712.

Lime shall be slaked on the spot, mixed and stirred thoroughly with sufficient quantity of water (about 4.5 litres per Kg. of lime) to make a thin cream. This shall be allowed to stand for a period of 24 hours and then strained through a clean coarse cloth. Clean gum dissolved in hot water shall then be added in the proportion of 4 gm. of gum Arabic to one litre of lime cream to prevent lime wash coming off easily when rubbed.

Indigo (Neel) up to 3 gm per Kg of lime dissolved in water shall be added and stirred well. Water at 5 litres per Kg. of lime is then added to produce a milky solution.

Alternatively ready made whiting (ground white chalk) complying to IS 63 can be used. In this case whiting shall be dissolved in sufficient quantity of warm water to form thin slurry, which shall then be screened through a clean coarse cloth. 2 gm. of gum and 0.4 gm. of copper sulphate dissolved separately in hot water shall be added for every litre of the slurry, which shall then be diluted with water to the consistency of milk for use. Rice size may be allowed instead of gum.

Colour wash shall be lime wash as above to which a solution of water and lime fast pigment, boiled if directed, shall be gradually added and stirred until the required tinge is available.

##### **Preparation of surface**

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means to be approved by the Engineer-In-Charge. All loose pieces and scales shall be stuffed with mortar and cured.

##### **Application**

Lime wash shall be applied with a brush. Each coat must be allowed to dry and shall be subject to an inspection before the next coat is applied. When dry, the surface shall not show any signs of cracking and shall present a smooth and uniform finish easily when rubbed with a finger. Patchy or streaky work will be rejected. No colour wash shall be done with a sample of the colour wash to the required tint or shade unless it is approved by the Engineer-In-Charge.

##### **Precautions**

Doors, Windows, floors etc., shall be protected from being splashed upon. Any splashing and droppings shall be removed and surfaces cleaned.

**Scaffolding**

Single or double scaffolding shall be provided by the Contractor as and when required.

**Measurements**

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats shall be 3 coats unless otherwise specified. The item to include removing nails making good holes, cracks, patches etc. not exceeding 50 sq.m. each with material similar in composition to the surface to be prepared.

**10.7. Painting**

All the water base and oil base paints such as distemper, cement paint, enamel paint, flat oil paint etc. shall be of approved manufacturers and shall conform to the respective IS Codes and Standards.

Colour and Shade shall be as approved by the Engineer-In-Charge.

**Supply**

All paint materials shall be supplied to the Site in the manufacturer's sealed and branded containers. Any containers reaching site with broken seals are liable for instant rejection by the Engineer-In-Charge.

**Storage**

All paint materials shall be stored in cool dry conditions clear of other stores to the satisfaction of the Engineer-In-Charge.

**Usage**

The mixing of materials of different brands before or during application shall not be permitted.

Brushes, pails, kettles and other implements and tools used in painting or preparation of the work shall be clean and free from foreign matter.

The instructions of the manufacturer shall be followed regarding preparation of surface and application of priming and finishing coats. In any event the following engineering practices shall always be followed while carrying out work as specified in IS 2395 Part-I & Part-II.

- a) No exterior or exposed painting shall be carried out under adverse weather conditions such as rains, extreme humidity, dust storms etc.,
- b) The work shall preferably be carried out in shade to avoid blistering or wrinkling due to direct sunlight.
- c) All surfaces to be painted shall be free of loose matter, efflorescence, dust etc. before application of each coat.

- d) No paint shall be applied to works, which are internally or superficially damp.

### **Preparation of Surfaces**

#### **General**

All surfaces requiring paint shall be thoroughly cleaned of all dirt, dust, grease or oil before spotting or priming. Oil or grease film shall be washed off with an acid that is non-injurious to the surface or shop primers and rinsed off completely with plain or soapy water. Surfaces shall be dry unless dampening is required for a particular finished material.

Before starting the work, the Contractor shall obtain the approval of the Engineer-In-Charge regarding the soundness and readiness of the surface to be painted on.

#### **Masonry, Concrete and Plastered Surfaces**

Surface shall be free from all efflorescence, mildew, loose paint or other foreign and loose materials. Surface with mildew or efflorescence shall be treated as follows:

- All mildewed surfaces shall be treated with an approved fungicide such as ammonical wash consisting of 7 gm. of copper carbonate dissolved in 80 ml. liquor ammonia and silica fluoride solution and allowed to dry thoroughly before paint is applied.
- All efflorescence shall be removed by scrubbing and affected surfaces shall be treated with a solution of muriatic acid in water (1:6 to 1:8) and washed fully with clean water and allowed to dry thoroughly.

Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surfaces uniformly textured. Where this type of re-surfacing may lead to the finishing paint being different in shade from the original surface, the surfaced area shall be treated with minimum one coat of cement primer, which shall be continued to the surrounding area from a distance of 100mm.

The plastered surface shall be carefully rubbed smooth and thoroughly cleaned with clean fresh water.

#### **Application**

The method of application shall be as per the recommendations of the manufacturer, wherever relevant. Applications shall be by hand brushing, rolling or air spray. All priming undercoats shall be applied by brush only. Rollers and spray equipments shall not be used for the purpose.

All materials shall be evenly applied, shall be free of sags, runs crawls or other defects. All coats shall be of proper consistency. All primer and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

All coats shall be thoroughly dry before being papered or before the succeeding coat is applied. Coats of paint as specified are intended to cover surfaces perfectly. In case the surface is not covered properly by applying the specifying number of coats, further coats shall be applied by the Contractor when so directed by the Engineer-In-Charge.

In case of selection of special shades and colour (not available in standard shades) the contractor shall mix different shades and prepare test panels of minimum size 1 metre square as per instructions of the Engineer-In-Charge and obtain his approval prior to application of finishing paints.

### **Equipment and Protection**

All brushes used for the job shall be clean and in good condition.

Spray painting equipment shall be a type that will produce full, even coatings, shall be equipped with grease and water separators and kept properly clean and well maintained at all times.

Sufficient drop cloths, shields and other protective equipment shall be used to prevent sprays or droppings from fouling surfaces not being painted. Empty containers, saturated rags and waste shall not be allowed to accumulate. Any required ventilating or isolating measures for protecting his workmen and others from toxic or unhealthy conditions due to painting shall be provided by the Contractor.

### **Cleaning up**

Cleaning of paint droppings and spilling, splashed or splattered, films and smudges from finished surfaces and areas not to be painted shall be carried out concurrently with the work to the satisfaction of the Engineer-In-Charge. At completion, all equipments, excess materials and containers shall be removed and the premises shall be cleaned of all painting waste and debris.

### **Measurements**

Length and breadth shall be measured correct to a cm and area shall be calculated in sq.m. correct to two places of decimals.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the percentage as described in above para to allow for girthed area.

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats shall be 3 coats unless otherwise specified. The item to include removing nails making good holes, cracks, patches etc. not exceeding 50 sq.m each material similar in composition to the surface to be prepared.

- Timber doors, windows etc. shall be measured flat (not girthed) overall including frames and all edges, cleats etc. shall be deemed to be included in the item.
- Steel doors, windows, etc. shall be measured flat (not girthed) including frames, edges, etc.
- All pipes shall be measured in running meters and shall allow for all specials, brackets, clamps, etc. which shall not be measured separately.
- Multiplying co-efficient for EACH SIDE for the various items shall be as follows:



**TABLE 15**

	<b>Multiplying Co-efficient</b>	
<b>Timber Doors, Windows etc</b>		
Panelled doors, windows etc.	1.00	1.30
Flush doors	0.80	1.20
Partly panelled & partly glazed doors, windows etc.	1.50	1.00
Fully glazed doors, windows etc.		0.80
Fully timber louvered doors, windows etc		1.80
<b>Steel Doors, Windows, etc</b>		
Plain sheeted doors, windows	1.10	1.10
Fully glazed doors, windows	0.50	0.50
Partly panelled, partly glazed doors, windows		0.80
Collapsible gates	1.50	1.50
Rolling shutters	1.10	1.10
<b>General</b>		
Expanded metal, grill work, railings, gates		1.00
Corrugated iron sheeting	1.14	1.14
AC corrugated sheeting	1.20	1.20
AC semi corrugated sheeting	1.10	1.10

**10.8. Oil bound Distemper**

In regards to materials, surface preparation, application, equipment & protection, cleaning etc. shall be as described above.

**Application****Priming coat**

The priming coat shall be with distemper conforming to IS: 428 in one coat. After the surface defects are treated with gypsum which is allowed to set hard and wiped clean, the priming coat is applied with distemper primer (when wall surface has not dried completely).

Newly plastered if required to be distempered before a period of six months shall be given a coat of alkali resistant priming paint conforming to IS: 109 and allowed to dry for at least 48 hours before distempering is commenced.

**Distemper coat**

After the primer coat has dried at least for 48 hours, the surface shall be lightly sand papered to make it smooth. Distemper is then applied in dry weather with a broad stiff brush in long paralleled strokes, each coat being allowed to dry before the next coat is applied. The subsequent coats shall be applied in the same way. Two coats of distemper shall be applied over primer coat to obtain an even shade. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of preceding coat. For old work the distemper shall be applied over the prepared surface in the same manner as in new work. 15 cm double bristled distemper brushes shall be used. After each days work, brushes thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work..

## **11. FLOORING**

### **Material**

All tiles shall be of first quality of Indian make and shall be uniform in size, true and square with sharp arises, perfectly flat, flawless without twist, cracks and other defects. They shall be procured from approved sources. The Contractor shall furnish to the Engineer-In-Charge samples of different varieties he proposes to incorporate in the work. The Contractor shall strictly conform only to the samples approved by the Engineer-In-Charge.

Tiles to be used for skirting and dado shall be of the same manufacture and shade as that for floors.

### **11.1. Workmanship**

The surfaces to be laid with flooring or dado shall be thoroughly hacked, joints of masonry racked, cleaned of all mortar scales and concrete lumps and loose materials etc. and washed to remove mud, dirt, oil, grease etc. from the surface and shall be thoroughly wetted.

All tiles shall be laid in a pattern given on the drawings or directed by the Engineer-In-Charge.

All tiles in floor shall be truly and evenly set and pressed in position to obtain uniform plane surface. The skirting tiles shall be in true plane, level and plumb.

Flooring/dado work shall not be started unless and until the surface is approved by the Engineer-In-Charge.

### **11.2. Glazed tile work**

#### **Material**

Material shall be generally as described under- Flooring specifications. Glazed tiles shall conform to IS 777.

Tiles shall be evenly and well glazed over the top surface and shall be grooved and recessed in parts on the rear face to provide the necessary key for mortar. They shall be of specified sizes and thickness . The tolerance on facial dimension shall be  $\pm 1.0$  mm. and  $\pm 0.5$  mm. in thickness.

For coloured tiles, only the glaze shall be coloured as specified.

#### **Mortar**

Cement mortars shall be as described as under –Mortar specifications and the proportion of mortar shall be as specified in the respective items of BOQ.

#### **Laying**

Tiles shall be soaked in water for at least 6 hours prior to their use in the job.

Tiles shall be laid on cement and sand mortar (1:3) bedding of average thickness of 20mm and shall be spread, tamped and corrected to proper levels and allowed to harden for a day before the tiles are set. Over this bedding neat grey cement slurry (1:3) mix of honey like consistency shall be spread at a rate of 3.3 Kg of cement per Sq.m.. Tiles shall be washed

clean and fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded and in true level and line with the adjoining tile. Cement slurry oozing out through the joints shall be immediately wiped clean. Joints shall be fine (width 1.5mm) and nearly undistinguishable. Joints shall be pointed with white cement and matching pigment and finished neatly. The flooring shall be thoroughly cleaned with suitable hydrochloric acid before handing over. Joints shall be of straight fit joints as shown on the drawing or as directed by the Engineer-In-Charge.

### **Pointing and Finishing**

The joints shall be cleaned off the grey cement slurry with wire / coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

### **Curing**

Work shall be properly cured for at least 7 days and kept well protected.

### **Measurement**

Measurement shall be as described under –IPS flooring specifications.

### **Rate**

The rate shall include the cost of all materials and labour involved in all the operations described above including wastage and application of cement slurry on base concrete / surface, filling of joints as specified above etc.

## **11.3. Glazed Ceramic Tiles Work**

### **Material**

Material shall be generally as described under- Flooring specifications. Ceramic tiles shall confirm to IS 13755 of 1<sup>st</sup> quality.

The finished tiles, when fractured will appear fine grained in texture, dense and homogeneous. Tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects.

### **Mortar**

Cement mortars shall be as described under –Mortar specifications and the proportion of mortar shall be as specified in the BOQ.

### **Laying**

Laying of ceramic tiles shall be as described under –Glazed tiles specifications.

### **Pointing and Finishing**

Pointing and Finishing shall be as described under-Glazed tiles specifications.

**Curing**

Work shall be properly cured for at least 7 days and kept well protected.

**Measurement**

Measurement shall be as described under- IPS flooring specifications.

**Rate**

The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on base concrete/ surface.

**12. DISMANTLING & DEMOLISHING**

The item wise detailed specifications are intended for the general description of quality, workmanship, etc. desired for the items covered in the Schedule of Items. The Specifications are not, however, intended to cover the minute details and the work shall be executed according to the relevant latest Indian Standard Codes. In absence of the later, the work shall be executed according to the prevailing local Public Works Department Practice or to the recommendations of American and British Standard Institution at the discretion of the Engineer-In-Charge.

**12.1. Scaffolding**

Single or double scaffolding shall be provided by the Contractor as and when required.

**12.2. Objective**

The desired technique to be adopted in carrying out the demolition and dismantling work of existing structure shall be such that the fragments falling out of such operation can be contained within the work area or taking suitable protection so as to prevent materials from going out. This would relieve the surrounding area from any uncertain or uncontrolled behaviour of dismantled materials.

The rubbish / materials after dismantling shall also be stored systematically and disposed off immediately outside the plant boundary in order to ensure no major formation of heaps inside / adjacent to the work site and not hamper in any way the normal business operation of the Employer.

The term demolition implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

The term 'Dismantling' implies carefully removing without damage (up or down). This shall consist of dismantling one or more part of the structures / facilities as specified or shown on the drawings.

**12.3. Precautions**

All materials obtained from dismantling or demolition shall be the property of the Contractor once the materials are taken out of the boundary of MDL after completion of the necessary gate pass and other formalities. But till such time the materials shall be kept in safe custody as per the directives of the Engineer-In-Charge.

The demolition shall always be planned beforehand and shall be done in reverse order of the one in which the structure was constructed. The scheme shall be got approved from the Engineer-In-Charge before starting the work.

Necessary propping, shoring and / or underpinning shall be provided for the safety of the adjoining work or property 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, as per the opinion of the Engineer-In-Charge, temporary enclosures or partitions shall be provided at the Contractor's cost.

Necessary precautions shall be taken to keep down the dust nuisance.

Dismantling shall be done 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 removed first. The dismantled articles shall be passed by hand, where necessary, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-In-Charge.

Where fixing is done by nails, screws, bolts, rivets, etc. dismantling shall be done by taking out the fixed items with proper tools and not by tearing or ripping of.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-In-Charge within work site for verification required for gate pass and other formalities for taking outside the boundary. All unserviceable materials, rubbish, etc. shall be disposed off immediately outside the Owner's premises as directed by the Engineer-In-Charge.

#### **12.4. General**

Necessary data such as building size, wall thickness, construction materials, etc. that may be required shall have to be collected by the Tenderer from MDL site at his own expenses.

#### **12.5. Information to be supplied by the Tenderer along with Tender**

The information to be provided for by the Tenderer, unless otherwise specified, shall include the following :

To submit his method of demolition duly supported by specifications and drawings and sequence of operation along with a list of equipment, plants and machineries to be employed during such operation, to meet the above mentioned objective.

#### **12.6. Work to be provided by the Contractor**

- a) To arrange all the formalities as per requirement of statutory rules, if his method involves use of explosives. He has to obtain permission from appropriate authority of buying, storing, handling & making use of explosives.
- b) To notify, the Employer for arranging to shut off all gas, water, electricity, steam and other service lines running over ground or underground. Any temporary service connections required for the demolition work shall be separately taken and arranged by the Contractor.
- c) Any preliminary work, necessary for Contractor's method of demolition.
- d) To furnish all materials, labour, tools and plant and all consumables required for this work and its related temporary work such as cordoning the area, staging etc.

- e) To furnish the details of safety measures for human life / property / structures, the Contractor proposes to take during the blasting operation of explosives, if he proposes to use on this demolition work. This should be strictly as per rules and regulations laid down by the concerned authority for explosives to be used in this work.

### **12.7. Work by Others**

No work under this specification will be provided for by any agency other than the Contractor, unless specifically mentioned otherwise elsewhere in the Contract or approved by the Engineer-In-Charge / Employer.

### **12.8. Codes & Standards**

The demolition work shall be carried out as per Indian Standard Code of Practice No. IS 4130 - 1970 (Safety Code for demolition of buildings) or any other relevant Indian Standard Specifications and Codes of Practice. If demolition by blasting is adopted IS 4081 (Safety Code for blasting and related drilling operations) shall be followed. However, if any, particular aspect of the work is not specifically covered by any Indian Standard Specifications or any other standard practices, Engineer-In-Charge's instruction shall be followed.

### **12.9. Execution**

The materials available after dismantling and demolition will be deemed to be the property of the Contractor once the material are disposed off from the plant boundary and the amount offered by the Contractor against each of the facilities / buildings / structures are received by the Employer.

It is presumed that the Contractor will adopt the most suitable method of demolition and dismantling to protect the materials and its surroundings. While doing so the Contractor shall ensure the following, which should be considered as binding towards the method and specification adopted by the Contractor:

- Total safety of the people working in the area of the Employer, other agencies employed by the Employer as well as those employed by the Contractor.
- Safety and no damage to the adjoining properties, facilities or services.
- Disposal immediately after dismantling to keep the area clean after the days work and not more than one truckload being accumulated.
- No noise or dust nuisance around the area of working.
- No obstruction to vehicular / pedestrian traffic during dismantling and disposal inside the plant boundary as well as outside municipal areas.
- No hindrance in the Employer's day to day production work or other operation.
- No accidents or other hazards.

### **13. MISCELLANEOUS**

#### **13.1. Brickbat Coba**

Brickbat coba shall be prepared from well-burnt hard broken bricks 5 mm. to 30 mm. in size proportioned as 1 Cu.m. of brick aggregate to 0.35 Cu.m. of slaked lime.

Brick aggregate shall be soaked in water for a sufficiently long time prior to its mixing with lime.

#### **13.2. Putty**

Putty shall be made by mixing and kneading whiting with sufficient linseed oil to render it into a stiff paste.

Putty used for fixing glass in wooden frames shall conform to IS 419 and that used for fixing in metal sashes to IS 420. Putty shall be free from impurities like dust, grit etc.

#### **13.3. Jointing Materials**

##### **Joint Filler**

Performed joint filler shall be of bituminous material, non-extruding and resilient type and conform to IS 1838.

##### **Sealing Compound**

Sealing compounds shall be of an approved brand and shall conform to Grade "A" of IS 1834. They shall have good adhesive properties free from any corrosive effect and shall not slump in vertical or inclined joint, nor shall they bleed into or corrode the materials with which they are in permanent contact.

## **14. ALUMINIUM WORKS**

### **14.1. Aluminium glazed door**

#### **Materials**

Aluminium alloy extruded sections used in the manufacture, dimensions, weight per meter run of extruded section shall be as recommended in IS : 1948 - 1961 and of fabricated form of approved / renowned companies.

Aluminium alloy used in the manufacture of extruded window sections shall correspond to IS Designation HE 9 WP of IS 733. Hollow aluminium alloy sections used shall conform to SI Designation HV9-WP of IS 1285. Machine screws used shall conform to the requirements of IS 1362. Also cadmium plated screws, nuts, washers, bolts, lugs of steel shall be used on direction of the Engineer-In-Charge.

#### **Anodizing**

Anodic coatings on aluminium and its alloys, shall be in confirmation with IS : 1868 - 1996. All aluminium material used shall be anodized for protection against corrosion in marine atmospheres. A thick coating of minimum 15- microns (on each face) from a sulphuric acid bath shall improve its corrosion resistance. Further, anodized sections should be double sealed or alternatively, sealed by exposure to steam.

The extrusions are anodized in different colours like silver, champagne, bronze and black as approved by the Engineer-In-Charge. A fool proof scaling system ensures durable finish for long lasting applications.

Anodized material received at site shall be with a certificate conforming coating of aluminium sections as specified. The Engineer-In-Charge may get the same tested from outside at the cost of contractor as per IS 5523.

Powder coated aluminium, if specified shall be used as approved by the Engineer-In-Charge.

#### **Glazing**

Unless otherwise specified, the glazing shall be of patent flattened Float glass of best quality conforming to IS: 2835. Glass shall be free from cracks and of approved manufacture. It shall be transparent, ground or figured as specified.

Glass shall be transparent or ground as specified, uniform in appearance and shall be free from specks, bubbles, smoke, veins, air holes, blisters, stains, scratches and other flaws and defects of specified thickness. All the glass panels shall have proper square corners, true & straight edges.

Tolerance in length and width of Float glass shall be  $\pm 2.0$  mm. for glass thickness above 3 mm. and maximum upto 6.3 mm.

For panels larger than 900 mm. plate glass (minimum thickness 6 mm.) shall be used unless otherwise specified.

Roughcast wired glass shall be 6 mm. Thick, unless specified.



Float glass shall not have defects greater than those given in Table of IS 2835. Tests shall be conducted, if asked, as specified in IS 2835 Appendix A, B, C at Contractor's own cost.

Unless otherwise specified in BOQ, normal thickness of glass for window shall be 5.5 mm thk. Weight @13.5 kg/Sq.m and for doors 6.3mm thk weight at 15.5 Kg/Sq.m.

### **Standard Sizes of Aluminium sections, Tolerances etc.**

**Manufacturing tolerances:** Dimensional extrusions are normally manufactured as per Indian Standard / British Standard Specifications. Special tolerances shall be mutually agreed upon.

**Tolerance on Cut length:** Tolerance on cut length shall be +5mm upto 6 metres and + 7mm above 6 metres.

**Tolerance in Weight:** Actual weight of section shall not vary by more than  $\pm 10\%$ .

**Fixing sizes of Doors for fabrication:** The type and the overall sizes of aluminium doors shall be as indicated in the drawings. The dimensions shown are overall heights and widths to the outside of frames of doors. These sizes are derived after allowing 12.50mm clearance on both sides breadth wise while 12.50mm sides in height. While manufacturing the aluminium doors to enable the fixing of the same easily in the openings provided in masonry correct to the specified sizes of doors.

### **Fixing of Glass panels**

Glazing shall be provided on the outside of the frames unless otherwise specified.

Fixing of glass panes shall be done with aluminium beading. Beadings are to be fixed with screws, spaced not more than 10 cm from each corner and intermediate not more than 20cm apart. When the glass panes are fixed with aluminium beading having mitred joints, epoxy resin or silicon sealant shall be applied between glass panes and sash bars and also between glass panes and the beading.

All glass panes shall be fixed within the aluminium framing by use of CP brass or stainless steel screws as specified in item 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. For normal size glass panes glazing clips are not provided. Screw threads shall be of machine screws and conform to the requirements of IS : 1362. Dimensions for screw threads for general purpose diameter range should be 0.25mm to 3.5mm.

Four glazing clips may be provided per pane for a size larger than 30cm x 60cm for all types and panes size exceeding 80cm x 200cm, 6 glazing clips shall be used. In case of doors without horizontal glazing bars, the glazing clips may be spaced according to the slots provided in the vertical members only if the spacing does not exceed 30 cm otherwise minimum 30 cm spacing or as specified shall be maintained.

The aluminium anodized extruded glazing beads or snap beading to be used should also be the product from the manufacturer of aluminium extruded sections used for fabricating doors. No beading manufactured by local units shall be permitted .

### **Fabrication**

Frames shall be square and flat, with the corners fabricated to a true right angle.

The fixed as well as openable frame shall be constructed by cutting sections to exact length, with corners mitred and welded. Mitred shutter frame joints must be cleated mechanically with aluminium cleats if approved by the Engineer-In-Charge. Where hollow sections are used with welded joints, argon-arc welding or flash butt welding shall be employed or, if approved, mechanical connection assembly.

Subdividing bars of units shall be tenoned and riveted into the frame.

Fittings and fixtures shall be as detailed or approved by the Engineer-In-Charge and confirming to IS 1948. Casement shutter shall have Peg stay, Handles, Locks. Samples of fittings shall be submitted prior to being used for final approval of the Engineer-In-Charge.

EDPM/Neoprene preformed profile shall be used for inserting into extruded pockets of sections. Glazing beads shall also be of EDPM/Neoprene preformed profiles to hold the glass in frame under pressure. Non metallic setting blocks shall be used to centralize the glass in frame. Stainless steel ball bearing of approved make, housed in nylon type nylon roller, shall be used.

All mechanical connection shall be sealed with silicon sealant. Around all windows, approved quality sealants shall be run down to make sure of total weather/water sealing. Fixing shall be carried out as per IS 1081.

**Frames:** 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.

### **Fittings**

All fittings and fixtures shall be of high quality and as shown in the drawing / as specified. The samples of all fittings shall be got approved by the Engineer-In-Charge before fixing. The general details of fittings for doors shall be as prescribed in IS : 1948 unless otherwise specifically specified.

### **Hinges**

Cast or extruded aluminium alloy hinges for doors shall be of same type as described under clause 3020.2, but of larger size. The type of hinges projecting or non projecting type shall be as specified in the item description or as directed by the Engineer-In-Charge.

### **Handles**

Handles for the doors shall be of the design as shown in the drawing and as specified in the item description or as directed by the Engineer-In-Charge.

### **Bolts**

In double shutter doors, the first closing shutter shall have a concealed aluminium alloy bolt at top and bottom and shall be so constructed as not to work loose or drop by its own weight.

Single and double shutter doors may be provided with a three way bolting device and in case of double shutter door, concealed aluminium bolts shall not be provided.

### **Position of holes and number of lugs per units-**

Outer frames shall be provided with fixing holes centrally located in the web of the section in the position as indicated in the drawing. Number of lugs to be provided as indicated in the drawings or as directed by the Engineer-In-Charge.

### **Fixing of Aluminium doors in position**

Aluminium doors shall be stacked as to keep them in true shape without damage. The sizes of opening in the masonry shall be larger in width by 1.25cm on both the side and larger in height of 1.25cm only on top face. This gap is to be filled up with mastic cement and plaster done after door is fixed in position.

### **Fixing with G.I Steel lugs**

Slotted G.I steel adjustable lugs shall be of natural finish and of size 100 x 16 x 3 mm.

Number of lugs and their position of fixing for an aluminium alloy door shall be as specified or as directed.

Before the aluminium doors are fixed in position, a thick shop coat of clear transparent lacquer based on the methyrate or cellulose shall be applied on aluminium doors, windows, etc. to protect the surface from wet cement during installation. The lacquer coating shall be removed carefully after plastering etc. to the satisfaction of the Engineer-In-Charge without any extra cost.

The size of the opening shall first be checked and cleared of obstruction if any. The position of the unit for fixing holes shall be marked on the jamb. Necessary holes shall be made in the masonry and lugs of size not less than 100mm long 15 x 3 mm size fixed in cement concrete blocks of size 150 x 100 x 100mm in 1:3:6 mix (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size). The frame of units after treating with lacquer coating as explained in above para shall be set in opening by using wooden wedges at jambs head (wedges shall be preferably placed near the points where glazing bar or other members meet.)

The wedges should be fixed only when the doors / windows are kept in perfect position and plumb. Later the frames should be fixed with lugs with 20mm long and 6.3mm dia. G.I. counter sunk machine screws and nuts. Only after ascertaining that the doors are firmly fixed with lugs in the opening, the wedges should be removed very carefully and the gap should be filled with mastic cement and plaster taking particular care to see that the plaster done over jambs do not in any way abut the front surface of aluminium door.

After the gaps are filled with mastic cement and plaster and the filling is finally set still if any crack / gap is noticed / pointed out by the Engineer-In-Charge the same should be immediately filled with either epoxy resin or silicon sealant.

### **Fixing on concrete surface**

Contrary to the method adopted as stated above in this case instead of using lugs to fix the doors the same is fixed with wood screws to the wooden plugs fixed in the concrete surface.

As in earlier case the opening is checked for size etc. the specified treatment is given to the surfaces of aluminium doors and the correct positions for fixing wooden plugs marked on the jamb with respect to the hoes provided in the door for fixing screws.

Only duly marked points on the jambs required size of hole shall be made in the concrete and the wooden plug of teak wood of specified size shall be fixed in the hole with rich cement mortar. Units shall be erected after plugs are duly set.

Door should be fixed to the wooden plugs, with the help of galvanized wood screws of size 45 x 10mm

Later the 12.5mm wide gap between the concrete surface and the aluminium unit shall be filled neatly with mastic cement and mortar. Alternatively if approved by the Engineer-In-Charge instead of fixing the units of wooden plugs the same can be conveniently and firmly fixed with rawl plugs using little longer size screws of designation 10.

### **Measurement**

Shall be as per the relevant part of IS 1200

**Frame work:** The length of each extruded section used for fabrication of the door shall be measured correct to 1mm. Length shall be measured by reducing the width by 2.5cm and height by 1.25cm than the specified size of doors in the drawings issued for construction.

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 manufacturer's catalogue, subject to the condition that the variation in actual weight given in the manufacturer's catalogue, and the actual weight should not exceed  $\pm 10\%$  than the weights specified in manufacturer's catalogue, payment shall be made for the actual weight of the extruded section. The final weights shall be calculated in Kgs upto two place of decimal.

### **Glazing**

Length and width of glazing louvers shall be measured correct to a cm and area shall be calculated in Sq.m. nearest to 0.01 Sq.m.

### **Fittings**

All fittings and fixtures for doors shall be inclusive of the rate. However, weight of the same will be ignore while calculating the weight of aluminium sections.

### **Rate**

The rate shall include the cost of material and labour for all operations described above including cost of glazing. The rate shall also allow finish of aluminium section to be supplied in mat finished and provided with 15 micron thick anodizing in approved colour as specified in the item description or otherwise as directed by the Engineer-In-Charge.

## **14.2. Aluminium glazed openable window**

### **Material**

Material shall be used as described under –Aluminium doors specifications relevant clauses as applicable.

### **Standard Sizes, tolerances**

Standard sizes/ tolerances etc. shall be used as described under-Aluminium doors specifications relevant clauses as applicable.

Fixing sizes of windows for fabrication: The type and the overall sizes of aluminium windows shall be as indicated in the drawings and should be reduced in size by 1.25 cm from all four sides while manufacturing the aluminium alloy windows to enable the fixing of the units easily in the openings provided in the masonry correct to the specified size of windows.

### **Glazing**

Glazing shall be used as described under –Aluminium doors specifications.

### **Fixing of Glass Panels**

Fixing of glass shall be used as described under –Aluminium doors specifications

### **Fabrication**

**Frames:** Frames shall be used as described under-Aluminium doors specifications.

**Shutters:** Openable windows shall be constructed to sections as detailed in drawings. The hinges, handles, peg stays etc. shall be provided as specified or as directed by the Engineer-In-Charge. Details of construction of aluminium alloy windows in accordance with IS : 1948

For double window shutter the first closing shall have a concealed aluminium alloy bolt at top and bottom so constructed as not to work loose or drop by its own weight.

Standard projecting type as specified or as directed by the Engineer-In-Charge shall be provided which shall be inserted into frames and reverted. For anodized work pins for hinges shall be of aluminium alloy HR30. The Engineer-In-Charge may permit the use of mechanical jointing instead of welding.

Openable shutters shall be provided with continuous neoprene weather strips.

### **Tolerances**

The sizes for openable windows shall not vary by more than  $\pm 1.5\text{mm}$

### **Fittings**

Hinges of approved quality and size shall be used for fixing the shutters as per the direction of Engineer-In-Charge.

### **Handles - For Side Hung Shutters**

The handles shall be of cast aluminium of specified quality, manufactured by reputed manufacturers.

The handles shall be mounted on a handle plate welded or riveted to the opening frame in such a way that it could be fixed before the shutter is glazed.

The handle should have anodized finish with minimum anodic film thickness of 15 micron. The handle shall have a two point nose, which shall engage with an aluminium striking plate on the fixed frame in a slightly open position as well as in a fast position.

The height of the handles, in each type of side hung shutters shall be fixed in approximate position as shown on the drawing specified or as directed by the Engineer-In-Charge.

### **Weather Bar**

When a coupling member is fitted over an external opening shutter the coupling member should incorporate an integrally extruded weather bar as per IS : 1948, Section No. A1 – HK12B.

Position of holes and number of lugs per unit – The position of holes and number of lugs to be provided for windows of different sizes in accordance with IS : 1948

#### **Fixing Aluminium Windows in position**

In opening of masonry: Aluminium windows shall be stacked as to keep them in true shape without damage. The sizes of openings in the masonry shall be larger in width / height by 1.2cm for all four sides. This gap is to be filled up with mastic cement and plaster after window is fixed in position.

#### **Fixing with steel lugs**

Fixing with steel lugs shall be used as described under-Aluminium doors specifications.

#### **Fixing on Concrete surface**

Fixing on concrete surface shall be used as described under- Aluminium doors specifications.

#### **Measurement**

##### **Framework**

The length of each extruded section used for fabrication of the window shall be measured correct to 1mm. Length shall be measured by reducing the width and height by 2.5cm than the specified size of window in the drawings issued for construction.

The weight of material used shall be calculated as described under Aluminium Doors specifications.

**Glazing** - Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m.

**Fittings** - All fittings and fixtures for windows shall be included in the relevant items. However, the weight of the same shall be ignore while calculated weight of aluminium sections.

#### **Rate**

The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws expansion hold fastener, snap beading including filling with necessary PVC / neoprene felt, cleats, etc. The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour and shall allow for openings of all shapes including circular, segmental or other shapes and sizes.

### **14.3. Aluminium glazed sliding window**

#### **Material :**

Material shall be used as described under –Aluminium doors specifications.

**Standard Sizes, tolerances, fixing sizes etc.**

Standard sizes/ tolerances etc. shall be used as described under-Aluminium Doors specifications under relevant clauses as applicable.

**Glazing**

Glazing shall be used as described under –Aluminium Doors specifications.

**Fixing of Glass Panels**

Fixing of glass shall be used as described under- Aluminium Doors specifications.

**Fabrication**

Frames : Frames shall be used as described under –Aluminium Doors specifications.

Shutters : Panels and type of sliding windows shall be manufactured as specified in the drawing, specified in the item description or as directed by the Engineer-In-Charge.

Fittings shall be self closing latch (normally fixed to the shutters while manufacturing the knob fixed on the sliding glass panes), nylon rollers etc.

**Tolerance**

The size of sliding windows shall not vary by more than  $\pm 1.5$ mm.

**Position of holes and number of lugs per units**

In absence of any guidelines issued by IS code for sliding windows. The position of holes and number of lugs to be provided for windows of different sizes in accordance with IS : 1948 and can be followed with suitable modifications, wherever necessary.

**Fixing Sliding Windows**

In opening of masonry: Aluminium windows shall be stacked as to keep them in true shape without damage. The sizes of openings in the masonry shall be larger in width / height by 1.2cm for all four sides. This gap is to be filled up with mastic cement and plaster after window is fixed in position.

**Fixing with steel lugs**

As described under –Aluminium Doors specifications.

**Fixing on Concrete surface**

As described under –Aluminium Doors specifications.

**Measurements**

Frames shall be measured as described under –Aluminium Doors specifications.

**Glazing:** Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m. However, the cost of knob fixed in the glass of sliding window glass need not be paid separately.

**Rate**

The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws expansion hold fastener, snap beading including filling with necessary PVC / neoprene felt, cleats, nylon rollers, etc. The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour and shall allow for openings of all shapes including circular, segmental or other shapes and sizes. The rate shall also include the cost of automatic closing latch provided in the sliding window while manufacturing.

The cost of glazing, panelling shall be paid under separate item, as described herein.

**14.4. Aluminium glazed fixed / openable ventilators****Material :**

Material shall be used as described under- Aluminium Doors specifications.

**Standard Sizes, tolerances, fixing sizes etc.**

Standard sizes/ tolerances etc. shall be used as described under-Aluminium Doors specifications under relevant clauses as applicable.

**Glazing**

Glazing shall be used as described under- Aluminium Doors specifications.

**Fixing of Glass Panels**

Fixing of glass shall be used as described under -Aluminium Doors specifications

**Fabrication**

**Frames :** Frames shall be used as described under-Aluminium Doors specifications under relevant clauses as applicable.

**Shutters :** Ventilators shall be constructed to sections as detailed in drawings. The hinges, handles, peg stays etc. shall be provided as specified or as directed by the Engineer-In-Charge. Details of construction of aluminium alloy windows in accordance with IS : 1948

Standard projecting type hinges as specified or as directed by the Engineer-In-Charge shall be provided which shall be inserted into frames and reverted. For anodized work pins for hinges shall be of aluminium alloy HR30. The Engineer-In-Charge may permit the use of mechanical jointing instead of welding.

Ventilators shall be provided with continuous neoprene weather strips.

**Tolerances**

The sizes for ventilators shall not vary by more than  $\pm 1.5\text{mm}$

**Fittings**

Hinges – Top Hung Ventilators



Friction hinges of approved quality and size shall be used for fixing top hung ventilators as per the direction of Engineer-In-Charge.

#### Cup Pivots Centre Hung Ventilators

The centre hung ventilators shall be hung on two pairs of cup pivots or on brass or bronze cup pivots which should be either chromium or cadmium plated and reverted to the inner and outer frames of the ventilator to permit the ventilator to swing through an angle approximately 85°.

The opening portion of the ventilators shall be so balanced that it remains open at any desired angle under normal weather conditions.

#### **Spring Catch – Centre Hung Ventilators**

The spring catch shall be of specified make and type conforming to relevant IS specifications and shall be made of either chromium plated or cadmium plated.

The spring catch shall be fitted in the centre of the top bar of the ventilator, for its operation. This spring catch shall be secured (preferably screwed or reverted) to the frame and shall close into the aluminium catch plate reverted or welded to the outside of the outer ventilator frame.

#### Cord Eye and Pulley Arrangement – Centre Hung Ventilator

Cord pulley wheel shall be of aluminium or cadmium plated brass in an aluminium bracket.

This shall be fitted at the sill of the ventilator, with aluminium or galvanized or cadmium plated steel screws or alternatively welded together with aluminium cord eye reverted or welded to the bottom inner frame bar of the ventilator in a position corresponding to that of pulley.

#### **Position of Holes and Number of Lugs per Unit**

The position of holes and the number of lugs to be provided for the ventilators of different sizes as described under –Aluminium Doors specifications.

#### **Fixing Aluminium Ventilators in position**

Fixing of Aluminium Ventilators shall be as described under –Aluminium Window specifications.

#### **Measurements**

Frames shall be measured as described under –Aluminium Doors specifications .

**Glazing:** Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m. However, the cost of knob fixed in the glass of sliding window glass need not be paid separately.

#### **Rate**

The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws expansion hold fastener, snap beading including filling with necessary PVC / neoprene felt, cleats, etc. The rate shall also

allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour and shall allow for openings of all shapes including circular, segmental or other shapes and sizes. The rate also includes the cost of fittings and fixtures.

The cost of glazing, panelling shall be paid under separate item, as described herein.

#### **14.5. Aluminium glazed louvered window with adjustable louvers**

##### **Material**

Material shall be used as described under -Aluminium Doors specifications.

##### **Standard Sizes, tolerances**

Standard sizes/ tolerances etc. shall generally as described under -Aluminium Doors specifications.

Tolerances in weight shall not vary by more than  $\pm 10\%$

##### **Sizes of Ventilators for fabrications -**

Overall sizes of aluminium adjustable louvered type ventilators shall be as specified in the drawings should be reduced by 1.25cm from all four sides while manufacturing.

##### **Glazing**

Glazing shall be used as described under -Aluminium Doors specifications.

##### **Fixing of Glass Panels**

Fixing of glass shall be used as described under -Aluminium Window specifications.

##### **Fabrication**

**Frames:** Frames shall be used as described under -Aluminium Doors specifications.

##### **Fixing of Glass panels**

Glazing shall generally as described under -Aluminium window specifications.

Glazed louvers shall be inserted inside the louvered frames. The glazed louvers can be removable type as and when required.

##### **Fittings**

Adjustable louvered frames, locking arrangement etc. shall be as per relevant IS code or as per the manufacturers norms subject to confirmation to relevant IS codes, or manufacturers instruction or otherwise as directed by the Engineer-In-Charge.

##### **Fixing of louvered ventilators**

Louvered ventilators shall be stacked as to keep them in true shape without damage. Fixing shall be in confirmation to relevant IS codes, or manufacturer's instruction or otherwise as directed by the Engineer-In-Charge.

## Measurements

### Frame Work

Frames shall be measured as described under- Aluminium Window specifications under relevant clauses as applicable.

**Glazing** - Length and width of opening for glazing inserts shall be measured correct to a cm and area of payment shall be calculated in Sq.m. nearest to 0.01 Sq.m. .

### Rate

The rate shall include the cost of material and labour for all operations described above except the cost of glazing (which shall be measured and paid separately) The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 15 micron thick anodizing in approved colour.

**14.6. Aluminium framed and panels made up of 4mm thick Synthetic Resin Bonded paper laminate with decorative facing on both side conforming to IS: 2036-1995 for toilets / bath / WC etc.)**

### Materials

General specifications shall be as described under- Aluminium Doors specifications.

### Frame :

Frames shall be as described under -Aluminium Doors specifications.

The sizes / sections of top, bottom, lock rail and style shall be of the sizes as mentioned on the drawings or otherwise as specified or directed.

### Panelling

Panelling shall have minimum thickness 4mm, it shall be synthetic resin bonded paper laminate with decorative facing conforming to IS : 2036 - 1995 and other technical data conforming to approved manufacturer specifications.

### Workmanship

General specifications shall be as described under-Aluminium Doors specifications.

Frames shall be square, flat and have been cut to length, mitred and mechanically jointed at the corners. All frames shall have corners welded to true right angles.

The panel inserts shall be either framed into the grooves. The depth of the groove shall be 12mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into grooves of stilts and rails to the full depth of groove leaving on space 1.5mm.

### Fixing of Shutters

Overall dimensions shall be within  $\pm 1.5\text{mm}$  of size shown on drawings. Actual weight of aluminium sections shall not vary by  $\pm 10\%$ .

Fixing of shutters shall be as described under Clause No. 3009.5 of under clause 3009 - Woodwork & Joinery.

**Fittings**

Fittings shall be as prescribed under Section 9 – Wood Work and general specifications shall confirm to IS : 1948 unless and otherwise specified. Fittings shall be measured and paid separately.

**Measurement**

Frame work and panelling shall be measured separately

**Frame Work**

Frames shall be measured as described under –Aluminium Doors specifications.

**Panelling**

For panelling length and width of opening for panels inserts shall be calculated to the nearest to 0.01 Sq.m. The portions of the panels inserts inside the groove shall not be measured for payment.

**Rates**

The rate shall include the cost of material and labour for all operations described above except the cost of panelling (which shall be measured and paid separately). The rate shall also allow finish of aluminium section to be supplied in mat finish and provided with 25 micron thick anodizing in approved colour. The frame work shall be paid in kg and panelling shall be paid in square meter separately.

## **15. WATERPROOFING WORKS**

### **15.1. Waterproofing Treatment**

Patented waterproofing treatments shall be done strictly in accordance with the manufacturer's specifications and in conformity with the relevant IS codes.

Any leakage or defects during guarantee period shall be made good by the Contractor at this own cost. The responsibility for all rectifications shall solely rest with the Contractor irrespective of the fact whether the specialised sub-contractor, if any, has given any guarantee to the Contractor.

### **15.2. Cement based patented type treatment for sunken portion of WC / Bath / Toilet / etc. for horizontal surfaces .**

Material and General specifications shall be as described under-terrace water proofing treatment specifications.

#### **Procedure for laying of India Waterproofing Type Treatment for WC's & Toilets etc.**

##### **Horizontal Surface**

The preliminary preparatory work shall be as described under -terrace water proofing specifications. After cleaning the surfaces and then laying 20mm thick waterproof cement plaster to surfaces of brick walls / concrete of sunken floors using graded sand and mixed with approved cement based integral waterproofing compound, finished smooth with a floating coat of neat cement.

Brickbat coba shall be laid in CM 1:2 as per specifications and shall be kept wet for at least 4-5 days period. Brick bat coba in the sunken 1:4:8 proportion shall be measured and paid separately.

The final treatment over the brickbat coba shall be carried out in one operations so that no construction joints are left. Finishing top surface with 15mm thick plaster in CM 1:6 with an admixture of approved chemical waterproofing compound.

The prepared surface shall be kept wet for at least 10 days period.

##### **Testing**

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

##### **Measurement**

The measurements shall be on the actual net area. For horizontal treatment the measurement shall be taken on plan area and measured only once. Brick bat laid shall be measured separately.

### **15.3. Cement based patented type treatment for sunken portion of WC / Bath / Toilet / etc. for vertical surfaces.**

Material and General specifications shall be as described under -terrace water proofing specifications.

## **Procedure for laying of India Waterproofing Type Treatment for WC's & Toilets etc.**

### **Vertical Surfaces**

Surface above the floor level shall be treatment with 20mm thick waterproof cement plaster in CM 1:4 with an admixture of approved chemical waterproofing chemical or as per manufacturer's specifications upto the specified height and the surface shall be roughened.

The treated surface shall be kept wet for at least 7 days period.

### **Testing**

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

### **Measurement**

The measurements shall be on the actual net area. Brick bat laid shall be measured separately.

### **15.4. Cement based waterproof brick bat coba for filling in sunken portion of WC / Bath / Toilet / etc.**

Material and General specifications shall be as described under –terrace water proofing specifications

### **Procedure for laying of Brickbat Coba as per India water Proofing Type Treatment**

After the expiry of the curing period of RCC slab, the surfaces shall be brushed and cleaned of all dust and foreign matter to lay the brickbat. The brickbat coba shall be laid and consolidated to proper slopes as directed by the Engineer-In-Charge to facilitate easy drainage of storm water and shall be of average thickness as specified in the item. The specifications for the materials, laying and curing etc. of this concrete shall be as specified in IS 3038.

Consolidation shall be done the next day by beating the surface with wooden beaters and shall continue on subsequent days till brick bat coba is properly consolidated and beater rebound and do not make any impression on the surface. During the process of beating, the surface shall be constantly kept wet by sprinkling water.

Graded brick bat coba in 1:4:8 mix (1 cement: 4 coarse sand: 8 brick bat coba, with 40mm nominal size) impregnated with approved water repellent / water proofing chemical compound properly consolidated to required depth, grade and slope.

### **Testing**

If leakage is observed wherever waterproofing treatment is carried out the source of leakage is to be detected and the same shall be stopped with the help of injection grouting (with cement slurry).

## 16. SNITARY APPLIANCES AND FITTINGS

14.1 All fittings shall be as specified in items.

**16.1.** All vitreous sanitary appliances (Vitreous China) shall conform to IS 2556 (Part-I) general requirements.

### 16.2. Flushing Cisterns

15 The flushing cisterns shall be automatic or manually operated high level or low level as specified, for water closets and urinals. A high level cistern is intended to operate with minimum height of 125 cm and a low level cistern with a maximum height of 30 cm between the top of the pan and the under side of the cistern.

### 16.3. Mirror

The mirror shall be of superior glass with edges rounded off or beveled, as specified. It shall be free / from flaws, specks or bubbles. The size of the mirror shall be 60 x 45 cm unless specified otherwise and its thickness shall not be less than 5.5 mm. It shall be uniformly silver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint. Where beveled edge mirrors of 5.5 mm thickness are not available, fancy looking mirrors with PVC beading/border or aluminium beading or stainless steel beading/border based on manufacture's specifications be provided nothing extra shall be paid on this account. Backing of mirrors shall be provided with environmentally friendly material other than asbestos cement sheet.

### 16.4. Pillar Taps

Pillar taps shall be chromium plated brass and shall conform to IS 1795 or as specified in item. The nominal sizes of the pillar tap shall be 15 mm or 20 mm as specified. The nominal size shall be designated by the nominal bore of the pipe outlet to which the tap is to be fitted.

Casting shall be sound and free from laps, blow hole and pitting. External and internal surfaces shall be clean, smooth and free from sand and be neatly dressed. The body, bonnet and other parts shall be machined true so that when assembled, the parts shall be axial, parallel and cylindrical with surfaces smoothly finished.

The area of waterway through the body shall not be less than the area of the circle of diameter equal to the bore of the seating of the tap. The seating of pillar tap shall be integral with the body and edges rounded to avoid cutting of washer. Pillar taps shall be nickel chromium plated and thickness of coating shall not be less than service grade NO.2 of IS 4827 and plating shall be capable of taking high polish which shall not easily tarnish or scale.

Every pillar tap, complete with its component parts shall withstand an internally applied hydraulic pressure of 20 Kg/sq. cm maintained for a period of 2 minutes during which period it shall neither leak nor sweat.

### 16.5. Sand Cast Iron Floor Trap or Nahani Trap

Sand cast Iron Floor trap or Nahani trap shall be 'P' or 'S' type with minimum 50 mm seal. However, if the plumbing is in two pipe system and with a gully trap at the ground level the minimum water seal shall be 35 mm. The traps shall be of self cleansing design and shall have exit of same size as that of waste pipe. These shall conform to IS 1729.

**16.6. Towel Rail**

The towel rail shall be of PTMT as specified and as per direction of Engineer-in-charge.

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**16.7. Toilet Paper Holder**

The toilet paper holder shall be of CP brass or vitreous china as specified and of size and design as approved by the Engineer-in-Charge. It shall be fixed in position by means of C.P. brass screws and rawl plugs embedded in the wall.

**16.8. Urinals**

**16.8.1. Half Stall Urinals:** They shall be of white vitreous China conforming to IS 2556 (Part 6). They shall be of one piece construction with or without an integral flushing box rim and provided with slots or alternative fixing arrangement at the flat back end. They shall be provided with ridges where integral flushing rim is not provided in the sides of the interior of the bowl, to divert the water towards the front line of the urinal where integral flushing box rim is specified, water spreaders provided shall conform to IS 2556 Part-6 (or as specified in CPWD specification). These shall be vitreous China of one piece construction with integral flush inlet. The tolerance of  $\pm 4$  per cent may be allowed on the dimensions specified.

**16.9. Wash Basins**

Wash basins shall be of white vitreous china conforming to IS 2556 (Part-I) and IS 2556 (Part-4). Wash basins either of flat back or angle back as specified shall be of one piece construction, including a combined overflow. All internal angles shall be designed so as to facilitate cleaning. Each basin shall have a rim of all sides, except sides in contact with the walls and shall have a skirting at the back. Basins shall be provided with single or double tap holes as specified. The tap holes shall be 28 mm square or 30 mm round or 25 mm round for pop up hole. A suitable tap hole button shall be supplied if one tap hole is not required in installation. Each basin shall have circular waste hole to which the interior of basin shall drain. The waste hole shall be either rebated or beveled internally with dia meter of 65 mm at top. Each basin shall be provided with a non-ferrous 32 mm waste fitting. Stud slots to receive the brackets on the underside of the wash basin shall be suitable for a bracket with stud not exceeding 13 mm diameter, 5 mm high and 305 mm from the back of basin to the centre of the stud. The stud slots shall be of depth sufficient to take 5 mm stud. Every basin shall have an integral soap holder recess or recesses, which shall fully drain into the bowl. A slot type of overflow having an area of not less than 5 sq. cm, shall be provided and shall be so designed as to facilitate cleaning of the overflow.

Where oval shape or round shape wash basins are required to be fixed these shall be fixed preferably in RCC platform with local available stone topping either fully sunk in stone top or top flush with the stone topping as directed by Engineer-in-Charge.

The wash basins shall be one of the following patterns and sizes as specified

- a) Flat back: 660 x 460 mm (Surgeon's Basin)
  - 630 x 450 mm
  - 550 x 400 mm
  - 450 x 300 mm
- b) Angle back: 660 x 480 mm
  - 400 x 400 mm



White glazed pedestals for wash basins, where specified shall be provided. The quality of the glazing of the pedestal ~all be exactly the same as that of the basin along with which it is to be installed. It shall be completely recessed at the back to accommodate supply and waste pipes and fittings. It shall be capable of supporting the basin rigidly and adequately and shall be so designed as to make the height from the floor to top of the rim of basin 75 to 80 cm or as specified in CPWD specification. All the waste fittings shall be brass chromium plated, or as specified.

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#### **16.10. Waste Fittings for Wash Basins and Sinks**

The waste fittings shall be of nickel chromium plated brass, with thickness of plating not less than service grade 2 of IS 4827 which is capable of receiving polish and will not easily scale off. The fitting shall conform in all respect to IS 2963 and shall be sound, free from laps, blow holes and fittings and other manufacturing defects. External and internal surfaces shall be clean and smooth. They shall be neatly dressed and be truly machined so that the nut smoothly moves on the body.

Waste fitting for wash basins shall be of nominal size of 32 mm. Waste fittings for sinks shall be of nominal size 50 mm.

#### **16.11. Water Closet**

**16.11.1. Squatting Pans (Indian Type W.C.): Squatting pans shall be of white vitreous china conforming to IS 2556 Part-I for General Requirements and relevant IS codes for each pattern as described below:**

- (i) Long pattern-conforming to IS 2556 (Part-3).
- (ii) Orissa pattern-conforming to IS 2556 (Part-3).
- (iii) Integrated type conforming to IS 2556 (Part-14).

13 Preferably Orissa type pan should be used.

Each pan shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flush pipes, or as specified in CPWD specification. The flushing rim and inlet shall be of the self draining type. It shall have weep hole at the flushing inlet to the pan. The flushing inlet shall be in the front, unless otherwise specified or ordered by the Engineer-in-Charge. The inside of the bottom of the pan shall have sufficient slope from the front towards the outlet and the surface shall be uniform and smooth to enable easy and quick disposal while flushing. The exterior surface of the outlet below the flange shall be an unglazed surface which shall have grooves at right angles to the axis of the outlet. In all cases a pan shall be provided with a (100 mm) S.C.! trap 'P' or 'S' type with approximately 50 mm water seal and 50 mm dia vent horn, where required by the Engineer-in-Charge.

**16.11.2. Wash Down Type (European Type W.C):** Water closets shall be of white vitreous china conforming to IS 2556 (Part-1) and 2556 (Part-2), as specified and shall be of 'Wash down type". The closets shall be either of the two patterns (Pattern I & Pattern II) and sizes as shown in or as specified in CPWD specification as specified. The closets shall be of one piece construction. Each water closet shall have not less than two holes having a minimum diameter of 6.5 mm for fixing to floor and shall have an integral flushing rim of suitable type. It shall also have an inlet or supply horn for connecting the flushing pipe of dimensions as shown in or as specified in CPWD specification the flushing rim may be boxed or open type. In the case of box rims adequate number of holes, on each side together with a slot opposite the inlet shall be provided. The flushing rim and inlet shall be of the self draining type. The water closet shall have a weep hole at the flushing inlet. Each water closet shall have an integral trap with either 'S' or 'P' outlet with at least 50 mm water seal. For P trap, the slope of the outlet shall

be 14 deg. below the horizontal. Where required the water closet shall have an antisiphonage 50 mm dia vent horn on the outlet side of the trap with dimension conforming to those given in or as specified in CPWD specification and on either right or left hand or centre as specified set at an angle of 45 deg. and invert of vent hole not below the central line of the outlet. The inside surface of water closets and traps shall be uniform and smooth in order to enable an efficient flush. The serrated part of the outlet shall not be glazed externally. The water closet, when sealed at the bottom of the trap in line with the back plate, shall be capable of holding not less than 15 litres of water between the normal water level and the highest possible water level of the water closet as installed.

#### **16.12. GENERAL REQUIREMENTS FOR INSTALLATION OF W.C. PAN**

**16.12.1.** The work shall be carried out, complying in all respects with the requirements of relevant byelaws of the local body in whose jurisdiction the work is situated.

**16.12.2.** Any damage caused to the building, or to electric, sanitary, water supply or other, installations etc. therein, either due to negligence on the part of the contractor, or due to actual requirements of the work, shall be made good and the building or the installation shall be restored to its original condition by the contractor. Nothing extra shall be paid for such restoration works except where otherwise specified.

**16.12.3.** For making good the damage to the under mentioned items of work, the specifications as given in the following paras shall apply, unless directed otherwise.

**(a) Masonry Work:** The masonry work shall be made good by using the same class of bricks, tiles or stones as was damaged during the execution of the work. The mortar used shall be cement mortar 1:5 (1 cement: 5 fine sand) or as directed by the Engineer-in-Charge.

**(b) Plain Concrete Work:** Concrete work for sub-grade of the flooring, foundations and other plain concrete works shall be cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size). A coat of neat cement slurry shall be applied at the junction with old work, before laying fresh concrete.

**(c) Cement Concrete Flooring and R.C.C. Work:** Cement concrete 1:2:4 (1 Cement : 2 Coarse sand: 4 graded stone aggregate 20 mm nominal size) shall be used after applying a coat of neat cement slurry at the junction with old work, and the surface finished to match with the surrounding surface.

#### **16.13. Rate**

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

#### **16.14. FIXING AND JOINTING OF PIPES AND FITTINGS**

##### **16.14.1. Jointing**

The interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right up to the back of the socket and carefully centered by two or three laps of treated spun yarn, twisted into ropes of uniform thickness well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required levels and alignment.

The leading of pipes shall be made by means of ropes covered with clay or by using special leading rings. The lead shall be melted so as to be thoroughly fluid and each joint shall be filled in one pouring.

The following precautions shall be taken for melting lead:

- (a) The pot and the ladle in which lead shall be put shall be clean and dry.
- (b) Sufficient quantity of lead shall be melted.
- (c) Any scum or dross which may appear on the surface of the lead during melting shall be skimmed off.

After the lead has been run into the joint the lead shall be thoroughly caulked. Caulking of joints shall be done after a convenient length of the pipes has been laid and leaded.

The leading ring shall first be removed and any lead outside the socket shall be removed with a flat chisel and then the joint caulked round three times with caulking tools of increasing thickness and hammer 2 to 3 kg. weight. The joints shall not be covered till the pipe line has been tested under pressure.

Use of collars for jointing is not permitted in any concealed or embedded location. However, in exposed locations where full length pipes cannot be fixed due to site constraints, collars (and not loose sockets) may be used subject to the following:

- (a) No two consecutive joint shall be with the use of collars.
- (b) The joint of collar with the cut/spigot end of the pipe shall be made on the ground in advance and tested against leakage before fixing.
- (c) Cut/spigot end of the pipes shall be inserted in the collars up to the projection inside the collar and jointing shall be done as in the case of socket and spigot joint. The jointed pipe line shall be at required level/slope and alignment.

**Note:** The dimensions of loose sockets shall correspond to those of appropriate nominal size of pipe.

#### **16.14.2. Testing**

In order to ensure that adequate lead is poured properly into the joints and to control waste in use of lead, at the beginning of work three or four sample joints shall be made and the quantum of lead per joint approved by the Engineer-in-Charge. All sand cast iron/cast iron (Spun) pipes and fittings including joint shall be tested by smoke test to the satisfaction of the Engineer-in-Charge and left in working order after completion. The smoke test shall be carried out as under:

Smoke shall be pumped into the pipes at the lowest end from a smoke machine which consists of a bellow and burner. The material usually burnt is greasy cotton waste which gives out a clear pungent smoke which is easily detectable by sight as well as by smell, if there is leak at any point of the drain.

**16.14.3. Measurements**

- (a) The pipes shall be measured net when fixed in position excluding all fittings along its length, correct to a cm.
- (b) When collars are used for jointing SCI pipes these shall be measured as fittings and shall be paid for separately.
- (c) No allowance shall be made for the portions of the pipe lengths entering the sockets of the adjacent pipes or fittings. The above shall apply to both cases i.e. whether the pipes are fixed on wall face or embedded in masonry.
- (d) No deduction shall be made in the former case from the masonry measurement for the volume of concrete blocks embedded therein. Similarly no deduction shall be made for the volume occupied by the pipes from the masonry when the former are embedded in the later.

**16.14.4. Rates**

The rate shall include the cost of all labour and materials involved in all the operations described above, excluding fittings, lead caulk jointing, the supply and fixing M.S. holder bat clamps and M.S. stays and clamps, floor trap and painting, which shall be paid for separately.

**16.15. Ball Valve (Brass)**

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 (as specified in CPWD specification). The ball valve shall be of following two classes:-

- (a) *High Pressure:* High pressure float valves are indicated by the abbreviation 'HP' and are designed for use on mains having pressure of 0.175 MPa or above.
- (b) *Low Pressure:* Low Pressure float valves are indicated by the abbreviation 'LP' and are designed for use on mains having a pressure up to. 0.175 MPa.

The ball valves shall be of following nominal sizes 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm. The nominal size shall correspond with the nominal bore of the inlet shanks. Polyethylene floats shall conform to IS 9762

**16.16. Bib Taps and Stop Valve**

Brass (or as specified in CPWD specification): A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction.

The bib tap and stop valve shall be polished bright. In case these are required to be nickel plated, the plating shall be of the first quality with a good thick deposit of silvery whiteness capable of taking high polish which will not easily tarnish or scale.

**16.17. CHLORINATED POLYVINYL CHLORIDE (CPVC) PIPES**

**16.17.1.** CPVC pipes & fittings used in hot & cold potable water distribution system shall conform to requirement of IS 15778. The material from which the pipe is produced shall consist of chlorinated polyvinyl chlorides. The polymer from which the pipe compounds are to be manufactured shall have chlorine content not less than 66.5%.

The internal and external surfaces of the pipe shall be smooth, clean and free from grooving and other defects. The pipes shall not have any detrimental effect on the composition of the water flowing through it.

Diameter and wall thickness of CPVC pipes are as per given in Table 22 below.

**TABLE 22**

Sr. No.	Nominal Size	Nominal Outside Diameter	Mean Outside Diameter		Outside Diameter at any point		Wall Thickness					
			Min	Max	Min	Max	Class 1, SDR 11			Class 3, SDR 17		
							Avg. Max	Min	Max	Avg. Max	Min	Max
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
I	15	15.9	15.8	16.0	15.8	16.0	2.2	1.7	2.2	-	-	-
ii	20	22.2	22.1	22.3	22.0	22.4	2.5	2.02	2.5	-	-	-
iii	25	28.6	28.5	28.7	28.4	28.8	3.1	2.6	3.1	-	-	-
iv	32	34.9	34.8	35.0	34.7	35.1	3.7	3.2	3.7	-	-	-
v	40	41.3	41.2	41.4	41.1	41.5	4.3	3.8	4.3	-	-	-
vi	50	54.0	53.9	54.1	53.7	54.3	5.5	4.9	5.5	-	-	-
vii	65	73.0	72.8	73.2	72.2	73.8	-	-	-	4.8	4.3	4.8
viii	80	88.9	88.7	89.1	88.1	89.7	-	-	-	5.9	5.2	5.9
ix	100	114.3	114.1	114.5	113.5	115.1	-	-	-	7.5	6.7	7.5
X	150	168.3	168.0	168.6	166.5	170.1	-	-	-	11.1	9.9	11.1

**Notes :** For CPVC pipes SDR is calculated by dividing the average outer diameter of the pipe in mm by the minimum wall thickness in mm. If the wall thickness calculated by this formula is less than 1.52 mm, it shall be increased to 1.52 mm. The SDR values shall be rounded to the nearest 0.5.

**16.17.2. Dimensions of Pipes**

The outside diameter, outside diameter at any point and wall thickness shall be as given in Table 22.

16.17.2.1. **Diameter:** The outside diameter and outside diameter at any point as given in **Table 22** shall be measured according to the method given in IS 12235 (part 1).

16.17.2.2. **Diameter at any point:** The difference between the measured maximum outside diameter and measured minimum outside diameter in the same cross-section of pipe (also called tolerance on ovality) shall not exceed the greater of the following two values:

- (a) 0.5 mm, and
- (b)  $0.012 d_n$  rounded off to the next higher 0.1 mm.

16.17.2.3. **Wall Thickness:** The wall thickness of the pipes shall be as given in Table 22. Wall thickness shall be measured by any of the three methods given in IS 12235 (part 1). To check the conformity of the wall thickness of the pipe

throughout its entire length, it is necessary to measure the wall thickness of the pipe at any point along its length. This shall be done by cutting the pipe at any point along its length and measuring the wall thickness as above. Alternatively, to avoid destruction of the pipe, non destructive testing methods such as the use of ultrasonic wall thickness measurement gauges shall be used at any four points along the length of the pipe.

#### **Tolerance on Wall Thickness**

- (a) For pipes of minimum wall thickness 6 mm or less, the permissible variation between the minimum wall thickness ( $e_{Min}$ ) and the wall thickness at any point (e), ( $e - e_{Min}$ ) shall be positive in the form of +Y, where  $y=0.1 e_{Min}+0.2$  mm.
- (b) For pipes of minimum wall thickness greater than 6mm, the permissible variation of wall thickness shall again be positive in the form of +Y, where y would be applied in two parts.
- (c) The average wall thickness shall be determined by taking at least six measurements of wall thickness round the pipe and including both the absolute minimum and absolute maximum measured values. The tolerance applied to this average wall thickness from these measurements shall be within the range  $0.1 e_{Min}+0.2$  mm (see Table 22).
- (d) The maximum wall thickness at any point shall be within the range  $0.15 Min$  (see Table 22).
- (e) The results of these calculations for checking tolerance shall be rounded off to the next higher 0.1 mm.

16.17.2.4. **Effective Length (Le):** If the length of a pipe is specified, the effective length shall not be less than that specified. The preferred effective length of pipes shall be 3, 5 or 6 m. The pipes may be supplied in other lengths where so agreed upon between the manufacturer and the purchaser.

16.17.2.5. **Pipe Ends:** The ends of the pipes meant for solvent cementing shall be cleanly cut and shall be reasonably square to the axis of the pipe or may be chamfered at the plain end.

The internal and external surface of the pipe shall be smooth, clean and free from grooving and other defects.

- 16.17.2.6.           **Opacity:** The wall of the plain pipe shall not transmit more than 0.1 per cent of the visible light falling on it when tested in accordance with IS 12235 (Part 3).
- 16.17.2.7.           **Effect on Water:** The pipes shall not have any determinate effect on the composition of the water flowing through them, when tested as per 10.3 of IS 4985.
- 16.17.2.8.           **Reversion Test:** When tested by the method prescribed in IS 12235 (Part 51 Sec 1 and Sec 2), a length of pipe 200 ±20 mm long shall not alter in length by more than 5 per cent.
- 16.17.2.9.           **Vicat Softening Temperature:** When tested by the method prescribed in IS 12235 (part 2), the Vicat softening temperature of the specimen shall not be less than 110°C.
- 16.17.2.10.          **Density:** When tested in accordance with IS 12235 (Part 14), the density of the pipes shall be between 1450kg/m<sup>3</sup> and 1650kg/m<sup>3</sup>.
- 16.17.2.11.          **Hydrostatic Characteristics:** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (part 8/Sec 1), the pipe shall not fail during the prescribed test duration. The temperatures, duration and hydrostatic (hoop) stress for the test shall conform to the requirements.
- 16.17.2.12.          **Thermal Stability by Hydrostatic Pressure Testing :** When subject to internal hydrostatic pressure test in accordance with the procedure given in IS 12235 (Part 8/Sec 1) and as per requirement given in **Table 23**, SI. No. (iv), the pipe shall not burst or leak during the prescribed test duration.
- 16.17.2.13.          **Flattening Test:** When tested by the method prescribed in IS 12235 (part 19), pipe shall show no signs of cracking, splitting and breaking.
- 16.17.2.14.          **Tensile Strength:** When tested by the method prescribed in IS 12235 (Part 19), the tensile strength at yield shall not be less than 50 MPa at 27 ± 2°C.
- 16.17.2.15.          **Fittings**

The fittings shall be as follows:

- (a) Plain CPVC solvent cement fittings from size 15 mm to 160 mm.
- (b) Brass threaded fittings.
- (c) Valve from size 15 mm to 160 mm
- (d) Brass *Threaded Fittings*: All types of one end brass threaded male/female adaptors in various fittings like coupler, socket, elbow, tee are available for transition to other plastic/metal piping and for fixing of CP fittings. Ball, Gate valves in CPVC are available in all dimensions. All fittings shall carry the following information:
  - (i) Manufacturer's name/trade mark.
  - (ii) Size of fitting

**17. Contractor to provide:**

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, the cost being held to be included in the Contract Rates :

- 1) All labour, materials, plant, equipment and temporary works required to complete and maintain the works to the satisfaction of the Engineer-In-Charge.
- 2) Lighting for night work, and also whenever and wherever required by the Engineer-In-Charge.
- 3) Temporary fences, guards, lights and protective work necessary for protection of workmen, supervisors, engineers or any other persons permitted access to the site.
- 4) All equipment, instruments and labour required by the Engineer-In-Charge for measurement of the works.
- 5) Any of equipment not specifically mentioned above which can reasonably be held necessary for the completion and maintenance of the works to the satisfaction of the Engineer-In-Charge.



**TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS****CONTENT**

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**I.S. SPECIFICATION APPLICABLE TO ENTIRE INSTALLATION WORK IN ADDITION  
RULES TO INDIAN ELECTRICITY ACT AND RULES AND FIRE INSURANCE RULE**

<b>Sr No</b>	<b>Title</b>	<b>Standard</b>
1	Code of practice for electrical wiring installations (third revision)	IS 732:1989
2	Code of practice for design, installation and maintenance of service lines up to and including 650 V	IS 8061:1976
3	Recommendations on safety procedures and practices in electrical work: Part 1 General (first revision)	IS 5216 (Part 1):1982
4	PVC Insulated cables for working voltages up to and including 1100 V	IS 694:1990/ IEC 60227-1 to 5 (1979)
5	Miniature circuit breaker boards for voltage up to and including 1000 Volt ac	IS 13032:1991
6	Low voltage fuses: Part 1 General requirements [superseded by IS 13703 (Part 1):1993]	IS 9224 (Part 1): 1979
7	<b>ELECTRIC WIRING ACCESSORIES</b>	
i	Ceiling roses	IS 371:1999
ii	Switches for domestic and similar purposes (second revision)	IS 3854:1997/ IEC 60669-1 (1998)
iii	Plugs and socket outlets of rated voltage up to and including 250 volts and rated current up to and including 16 amperes - Specification (third revision)	IS 1293:2005/ IEC 60884-1 (2002)
8	<b>MISCELLANEOUS</b>	
	Adhesive insulating tapes for electrical purposes: Part 1 Tapes with cotton textile substrates	IS 2448 (Part 1): 1963

**GENERAL INSTRUCTIONS**

**1. SPECIAL INSTRUCTIONS**

- 1.1. Actual work shall be carried out by persons holding valid PWD Wireman License. The electrification work shall be supervised by persons holding PWD Supervisors License / Diploma Holder.
- 1.2. The work of electrification shall be carried out after the layout is finalized and as per the instructions given from time to time by site engineer. The electrical installation shall be as per the Indian standard codes and in conformity with Indian Electricity rules 1956, as amended up to date, and also the relevant regulation of licensee.
- 1.3. The scope of electrification work will include providing labour, material, transport, insurance security, clearing of site, handing over and one year free maintenance of the work from the date of commissioning. The material used shall be new and of category makes specified or approved. Any work where specifications are not clear, relevant provision in I.S. or Indian Electricity rules shall be followed. Engineer's decision and direction in such cases shall be final.

- 1.4. Site Engineer's of MDL approval in writing shall be obtained prior to commencement of the work to the following:-
- (a) Layout of wiring.
  - (b) Sizes of Cables.
  - (c) Layout of electrical lighting arrangement.
  - (d) Main Power DB.
  - (e) Make of the materials, fittings / fixtures / Fan, etc. which shall be of the approved make.

## **2. QUALITY OF THE MATERIAL**

- 2.1. All the materials shall be new from the fresh stock and shall confirm to I.S. specifications. When standard does not exist, such material / sample shall be submitted for site Engineer's of MDL approval, with Test Certificate from Government approved laboratories.
- 2.2. Contractors shall produce, on demand, such details as called for by the site Engineer of MDL to prove the genuineness of the material.
- 2.3. Rejected materials must be replaced by the contractors within 7 (seven) days.

## **3. WORKMANSHIP**

The work shall be carried out keeping in mind the aesthetic requirement of individual site and matching of final work with the surrounding by proper finishing as necessary to maintain uniformity. Good workmanship is an essential requirement of this contract. Poor workmanship will be liable for penalization.

## **4. MEASUREMENT & CANCELLATION OF THE PART CONTRACT**

The bills of the quantities are based on the plans of the buildings/ individual office showing the approximate location of all outlets, switchgear, etc. and are approximate only. The contractor shall be paid at actual as measured jointly by the representatives of the Contractor and Site Engineer of MDL.

## **5. INSPECTION & TESTS**

- 5.1. The Contractor shall offer each and every equipment for test at the works or otherwise test certificate shall be furnished in case inspection is waited.
- 5.2. All the materials shall be approved before starting the work.
- 5.3. PVC switchboards shall be ISI and approved make.
- 5.4. Wiring shall be approved before boards or blocks are fixed up.
- 5.5. Casing-N-Capping / Conduit pipes shall be inspected before erection.
- 5.6. Mounting arrangement of the exhaust fans / LED fittings / spotlights shall be inspected and approved by the Site Engineer, MDL.
- 5.7. Connections to earth electrodes shall be inspected and got approved by the Site Engineer, MDL, prior to connection.

## **6. DRAWINGS & CERTIFICATION:**

The contractor shall submit, following certificates, in duplicate, to the Site Engineer, MDL, for record purpose after the completion of the work.

- 6.1. Completion Drawings of in built layout of cable (Power DB, Computer power DB, etc.)
- 6.2. Copies of Completion Certificate and Test Report submitted to Manufacturer.
- 6.3. Any other Certificate / Reports as called for by the Site Engineer, MDL.
- 6.4. Instruction & Operation Manuals, Catalogues, etc.
- 6.5. On completion of the work, 3 (Three) sets of wiring diagram with proper symbol shall be prepared and submitted to the Site Engineer, MDL.

All wiring diagrams shall indicate clearly the main Power Distribution Board, MCB Distribution Board, switchboards, the runs of various mains and sub-mains and position of all the points and their control. All circuits shall be clearly indicated and numbered in the wiring diagrams and all points shall be given the electrical connection.

## **7. WIRING:**

- 7.1. All the wiring shall be done on the distribution system with the main and branch distribution boards at convenient physical and electrical load centre.
- 7.2. All runs of wiring shall be laid in such a manner that crossing is avoided.
- 7.3. All runs of wiring and exact position of all points and switchgear shall be first marked on the building or plan given MDL itself and approved by the Site Engineer, MDL.
- 7.4. Single / Multi-strand single / Double PVC/ FRLS cables shall be from fresh stock. Lights and fans shall be wired on a common circuit, including socket outlets.
- 7.5. As regards power circuits, in no case, there shall be more than 2 (Two) power points (16Amp) on each circuit.
- 7.6. When conductors pass through walls and floors, the conductors shall be wired through rigid pipe PVC sleeves of suitable size permitting easy passing of the wires. The ends of sleeves shall be neatly fixed with PVC bushings.
- 7.7. All exhaust Fans shall be wired through junction boxes.
- 7.8. The fittings shall be suspended by double suspension pipe rod of 16 gauge 20 mm dia H.G conduit duly threaded and painted with two coats of enamel paint for erection of tube light fitting with necessary check nuts and 2 or 3 core copper flexible wire 24/2 mm for connecting leads.
- 7.9. All the fittings shall be supplied complete with all the standard accessories and they shall be duly wired. Termination should be made in Junction Box in aluminium alloy LM6 construction with internal dia 100mm depth 60mm with 3/4"ET entries 4 way certified by CMRS for group IIA & IIB Terminal, 4 Nos of 2.5 sqmm.
- 7.10. All the teakwood articles shall be given one coat of varnished shellac conforming to I.S. 347-1952 over an application on marketed articles. If no application has been made earlier, two coats of varnish shellac conforming to I.S. 347-1952 shall be given.

## **8. PVC Conduits Pipes**

- 8.1. The contractor shall supply and install conduits as specified. All accessories, fittings required for making the installation complete including inspection tees and elbows, check nuts, male and female PVC reducers and gland, sealing fittings, junction boxes, box covers and saddles. All supporting accessories shall be supplied by the contractor. Conduit fittings shall be of the same material as the conduits i.e. all fittings shall be PVC as the case may be.

- 8.2. Conduits shall run along walls, floors, ceilings in accordance with relevant layout drawings or as directed by Engineer in Charge. Conduits shall be run as directly and as possible along with generally indicated route between two points with minimum length and width, minimum of crossing, bending and cutting but without creating interference with other installations.

## **9. LIGHTING SYSTEM & POWER RECEPTACLES:**

- 9.1. The contractors shall supply all lighting switches, power receptacles, MCB distribution boards complete with MCB & neutral terminal blocks and earthing terminal, glands, supporting and anchoring materials, to make the installation complete. The contractor shall also supply all lighting fixtures complete with LED tubes and cables. All materials, fittings and appliances used in the electrical installation shall conform to the I.S. specifications and technical specification mentioned in BOQ.
- 9.2. Wiring shall be colour coded so as to enable easy identification of phase, neutral and earth wire.
- 9.3. Main Power distribution boards shall conform to the stipulations of IS 732 or as approved by the Site Engineer, MDL at site.
- 9.4. Receptacle and lighting fixtures shall be fed from different circuits.
- 9.5. All exposed metal parts of the plug, when the plug is in complete engagement with the socket outlet, shall be in effective electrical connection with the earthing pin.
- 9.6. Metal conduits and fixtures shall be grounded properly by tinned copper wires by means of approved type grounding clamps efficiently fastened to the conduit pipe with earthing clips. To achieve perfect electrical continuity, the conduits shall be bounded effectively on both end of couplings and other points. Conduits shall be grounded at the ends adjacent to switchboards at which they originate or otherwise at the commencement of the run by a grounding conductor connected to an earth clip, clamp or gland in active electrical contact with the conduit.
- 9.7. Installation tests stipulated in IS 732 and other codes or practices shall be carried out by the contractor in the presence of the Site Engineer, MDL, before putting the installation in service.

## **10. LIGHTING FIXTURES:**

- 10.1. The lighting fixtures offered shall comply with the following requirement:
- i. The fixtures shall be suitable for operation on a normal supply of 240 Volts, Single Phase, 50 Hz, A. C. with a voltage variation of  $\pm 6\%$ .
  - ii. All fixtures shall be designed for minimum glare. The finish of all parts of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.
  - iii. All fixtures shall be designed for continuous operation under atmospheric conditions specified without reduction in lamp life, deterioration of material and internal wiring.
  - iv. For multi-lamp fittings, the circuit should be designed in such a manner as to reduce the stroboscopic effect to the minimum.
- 10.2. Lighting fixture reflectors shall generally be manufactured from sheet steel or aluminium of not less than 22/24 SWG. Fixtures shall be readily removable from the housing for cleaning and maintenance without disturbing the lamp and without the use of tools. Fixtures shall be securely mounted to the housing by means of positive fastening devices of a captive type. The gauge of the C.R.C.A. sheet shall be as per manufacturer's design.

- 10.3. Each fixture shall be complete with a four way terminal block for the connection and looping of incoming and outgoing supply cables. Each terminal shall be able to accept two 6 sq. mm solid aluminium conductors.
- 10.4. Each lighting fixture shall be provided with a grounding terminal.
- 10.5. On completion of manufacture, all surfaces of the fixtures shall be thoroughly cleaned and degreased. The fixture shall be free from scale, dust, sharp edges and burrs.
- i. The enamel finish shall be as per standard, non-porous and free from blemishes, blisters and fading.
  - ii. The surface shall be scratch resistant, and shall have no signs of cracking or flaking when bent through 90 degree on a 12mm diameter mandrel.
  - iii. All light reflecting surfaces shall have optimum light reflecting co-efficient such as to ensure the overall light specified.
  - iv. All reflectors and louvers shall be finished to the standard as the fixture housing.
- 10.6. The following routine tests shall be conducted as per the relevant Indian Standards:
- i. Each fixture completes with its proper lamp / lamps shall operate satisfactorily at its normal voltage and frequency.
  - ii. Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished.
  - iii. All luminaries provided with glass covers shall be subjected to thermal shockproof test. This test shall be conducted to ensure that the cover glass will withstand sudden variation in surface temperature due to rainfall or splashing water when the lighting fixture is fitted. The cover glass shall be heated in an oven to attain a steady temperature of 100°C and then plugged into cold water. No crack should develop.

## **TECHNICAL SPECIFICATIONS**

### **11. DISTRIBUTION BOARDS:** (incoming MCCB/MCB, outgoing MCB)

The DBs shall be suitable for operation on 3-phase/single phase 415/230 Volts, 50 cycles. The DBs shall comply with the addition of relevant Indian Standards and Indian Electricity Rules and Regulation.

Fabrication, supply, installation and commissioning of three-phase/single phase DB with neutral using C.R.C.A. sheet steel 18/20 SWG std. If 16/18 SWG/1.62/1.21mm is not available in market for approved makes by MDL. Distribution boards with front operated door, D.P & TPN switches with neutral link connectors for incoming and outgoing circuits. 'L' or suitable series miniature circuit breakers of appropriate rating mounted on DIN rail and enclosed in slotted lid type boards with PVC insulated wires of copper conductor for interconnection. The DB shall be mounted on angle iron frame with anchor fastener grouted in the wall as per specification. The cost is inclusive of interconnection with PVC insulated copper wires and sleeves / PVC flexible pipe, glands etc. in cost of DB. Charges for marine plywood and M.S angle iron frame are not included in the rate of DB. The SP, DP, TP MCB shall be as per Interconnection charges are included in cost of distribution board.

### **12. FUSE SWITCH UNIT:**

Scope: Specification No (SW-SWR/MDP)

Supplying and erecting IC/Metal clad DP switches of specified rating on angle iron frame of suitable size.

Material:

*DP Switch:* Single phase Double pole metal / iron clad weatherproof air break switch fuse unit, conforming to IS: 13947 (part- 1 &3)/ 1993 with facility to de-link neutral, suitable for single phase 240 volts, 50 Hz AC supply, having positive make break arrangement with shrouded incoming contacts, cable entry holes, sealing arrangement and mounting arrangements.

Fabrication: Required size of angle iron / MS Flat.

Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.

*Hardware:* SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.

Grouting Material: Cement, Sand, Putty, water, etc.

Method of Construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table no. 5.1/1 with the help of required nut bolt washer etc. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement concrete etc. Frame shall be painted prior to erection.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

### **13. MINIATURE CIRCUIT BREAKERS (MCBs)**

**General Specification for MCB's:**

MCB's shall be of current limiting type, ISI marked confirms to IS 8828 -1996. The power loss per pole shall be low and shall be in accordance with IS 8828 – 1996. All cable entries shall be either from bottom or top. Miniature circuit breakers shall have quick make and break non-welding self wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation and shall conform to relevant Indian Standards. All the active, live parts of MCB's should be out of human reach, ensuring safety & conforms to IP: 55 degree of protection. The MCB's must house transparent label holder to ensure circuit identification. The MCB's must have fully insulated safety shutters. The MCB's shall have lockable switching lever. The minimum electrical endurance shall be 20,000 operations. The housing of the MCB shall be mounted self-extinguishing DMC (Dough Moulding Compound). The short circuit current shall be brought to zero within 4-5 milliseconds from the time they are established. All MCB's shall have a minimum short circuit capacity of 10 kA RMS.

Material:

Single pole / Single pole with neutral / Double Pole / Triple pole / Four Pole: MCB, ISI marked as per IS 8828: 1996 (IEC 60898) with hammer trip and watch mechanism 15 arc plates, 10 kA capacity with nominal rating of 240/415V.

Lugs: Copper lugs of suitable size.

Method of Construction:

MCB's shall be erected in provided enclosure / distribution board and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis.

**14. FITTINGS AND FIXTURES:**

**14.1 Light Fitting suitable for LED Tubes**

Scope: Supplying & erecting Light fitting suitable for specified 22W of T8 LED Tubes with all accessories, erected with provided bracket at any place as directed by site engineer.

**14.2 LED Tube Light Fixtures :**

Supply and installation of LED Tube light.

LED Tube-lights with a maximum system wattage of 22 Watt. It should be made out of high quality materials and complying with industrial standard practices to ensure high reliability and long life. The entire LED tube light shall be capable of withstanding stresses and vibrations having necessary design/strength and protections inbuilt in its electronics within the specified electrical parameters of the product. Tube light should be provided with High quality long lasting PMMA poly acrylic front cover that should be distortion free, heat Resistant, Toughened, UV stabilized fixed to the extruded linear cast Aluminium frame.

**A. General Conditions**

Following codes and acts with its latest amendments shall be applicable for this work:

- i) Indian Electricity Act, 2003 with amendments thereto if any
  - ii) Indian Electricity Rules, 1956
  - iii) CEA Regulations -2010
  - iv) Relevant standards of the Bureau of Indian Standards (IS Codes) /International standards.
  - v) American Society of Testing of Materials (ASTM Codes).
  - vi) Other approved standards and / or Rules and Regulations related to the add subject matter of tender.
- a) Design, materials, and workmanship shall satisfy all the applicable standards, specifications and codes as applicable for LED Lighting Fixtures as below :
- b) Scope of work as described in tender document is not limiting in so far as the responsibilities of Vendor is concerned and shall include carrying out all works and providing all facilities that are required for commissioning of LED Lighting fixtures complying fully with all requirements as envisaged, complete in all respect



and satisfying all Performance and guarantee requirements as stated or implied from contents of tender document.

- c) Installation Instructions: Remove or bypass ballast(and starter, if present) for LED tube light fixtures.

## **B. TECHNICAL REQUIREMENT**

### **• FOR LED**

LED Efficacy - Greater than 100 lumens/watt @ 350mA drive current. (To be confirmed by LM-79 test report).

LED Type: - SMD type only.

Suggested LED Chip: Cree Inc. / Nichia Corporation/ OSRAM/Philips Lumileds / Seoul Semiconductor (To be confirmed by LM-79 test report)  
Reported life span of LEDs used in Luminaries: Greater than 50000 Hrs at the soldering point temp of 85 deg C & at luminaries driving current.

Colour Temperature of the proposed white colour LED : 5700K (i.e. 5665K +/- 355K, as per ANSI standard C78.377A). Colour point shall fall within the 7 step McAdam as per ANSI standard C78.377A.

Colour Rendering Index (CRI): Greater than equal to 80 (To be confirmed by LM-79 test report).

Length of LED tube light: 1200 mm (suitable for replacement of conventional T8, 4 feet tube light in existing fittings with minor wiring changes in existing fitting as per site requirement)

Working temperature: - 10 degree C to +45 degree C

Working humidity: 10% to 85%

### **• FOR LED DRIVERS :**

Efficacy Min: 85% (for driver power output  $\leq$  100W)

Power factor of complete fitting : Greater than 0.90

Input Operating Voltage: 140 V to 277 V AC.

In Built Cut Offs :140 V (LOW), 277 V (HIGH)

Driver surge protection standard: Min. 3KV

Total Harmonic Distortion (THD) : Less than 20% at full load

## **C. Following protection shall be provided in LED Lighting Fixtures:**

- a) Over voltage both at Input and Output.
- b) Over current both at Input and Output.
- c) Short circuit
- d) Surge protection

## **D. Tests / Inspection:**

Test Reports to be submitted along with offer for the following:

i. CISPR 15/ IS:6573

ii. IEC: 61547 (AS LISTED BELOW)

IEC 61000-4-2/IS:14700 PART 3: SEC:2, IEC 61000-4-3, IEC 61000-4-4 / IS:14700 PART 3: SEC4, IEC 61000-4-5 3KV or 4KV as offered.

IEC 61000-4-6, IEC 61000-4-11 / IS:14700 PART 3: SEC11

iii. IEC:61000-3-2 ( class C ) / IS: 1534 part 1 (d) IEC: 61000-3-3 / IS 14700 Part 3:Sec 2

Driver Safety requirement Standards: IEC: 61347-2-13 / EN:61347-2-13 / IS:15885-2-13. Test Reports to be submitted.

**Inspection will be done in 2 stages.**

**Stage-1:** Inspection of LED Modules before assembly.

**Stage-2:** After Completion of Assembly & Manufacturing to ensure performance.

- a) All standard tests on LED Lighting fixtures in accordance with the standards adopted & as per QAP shall be carried out at manufacturer's works so as to ensure efficient operation and satisfactory performance of all components / parts of LED lighting fixtures.
- b) Work is subject to inspection at all times and at all places by MDL
- c) Vendor shall carry out all instructions given during inspection and shall ensure that work is carried out according to relevant codes of practice & QAP.
- d) Decision of MDL in regard to quality of work and materials and performance to specifications shall be final & binding on vendor. If any item is found not conforming to standards during test/inspection, the same shall be replaced / rectified by Vendor without any cost to MDL and shall be re-offered for inspection within reasonable period at factory test.

**E. Warranty**

- a) The bidder shall guarantee for full replacement of LED tube lights (free of cost) due to any failure in 72 (Seventy Two) months from the date of delivery. Failure shall include failure/ deterioration of LEDs in terms of performance like guaranteed luminous efficiency, abnormal lumen depreciation, failure of driver unit.
- b) The vendor shall have final and total single point responsibility for the design and performance of the LED lighting fixture, driver, control gear and all components supplied under this specification.
- c) The supplier shall,
  1. Warrant that the LED lighting fixture, driver and all materials to be free from defects in Design, material and workmanship.
  2. Warrant that the LED lighting fixture will satisfy the requirements of the intended use and be suitable for the application.
  3. Agree to repair or replace any component under this warranty at site with prevailing model of same make, which proves to be defective during **guarantee period of 72 months**. The fixture shall have suitable mounting arrangement on poles/walls with extended portion of control gear.

**14.3 Exhaust Fans**

Scope:

Supplying and erecting Exhaust fan of specified sweep and speed, with all accessories and necessary materials, suitable to work on 230 V/415 V, AC Supply 50 Hz, erected in position.

Specification No : (FG-FN/EXF)

Material:

ISI marked Exhaust fan suitable for Single/Three phase AC 230/415 Volts 50 Hz, capacitor run with mounting ring, four numbers of fixing hole without regulator and louvers. The weep and speed shall be as per table below. Fan motor with moisture proof treatment and E class insulation, ISI marked, conforming to IS: 2312/67 with amendments 1 to 8. The fan mounting rings shall be proper pre-treatment followed with at least two coats of primer; final finish shall be with two coats of grey colour paint duly baked. The connecting leads shall be brought out for making connections.

Paint: Superior quality enamel paint of specified colour.

Corresponding Speed with Sweep

Method of Construction:

The Exhaust fan complete with all above accessories and duly wired shall be erected at specified position, connected to the supply and tested.

Testing:

After erection fan shall be tested by connecting to supply. Also steadiness and vibrations if any, of fan shall be checked at full speed, so that there is no wobbling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

**14.4 Mirror Light Fitting Suitable for CFL 9/13/18 watts (ML1)**

Scope: Specification No : (FG-IDF/ML1)

Supplying and erecting luminaries suitable for 9/13/18 watt CFL lamp made of engineering Plastic in approved colour finish and an elegantly designed milky white acrylic front diffuser, and bright anodized Aluminium reflector, with VPIT ballast, lamp holder, and connector.

Material:

Fitting: The Luminaries Comprises housing made of engineering plastic in approved colour finish and an elegantly designed milky white acrylic front diffuser enclosing a bright anodized Aluminium reflector. Pre-wired with vacuum pressure impregnated copper ballast, lamp holder and mains connector with two holes on rear side facilitates wall/ceiling mountings, the grommet should be provided at rear side.

Wooden board: As specified in chapter for Point wiring. (WG-PW/PW)

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Terminal connector: As per (FG-FG/AS10)

Connection Wire: Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Method of Construction:

The fitting shall be mounted on polished Wooden / Laminated 4mm plywood top / block by required size of screws with necessary flexible wire for connection.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

**15. Point wiring (Surface type)****15.1. Scope:****Point wiring (Surface type):**

Providing all required approved specified material including hardware and erecting wiring on surface of wall, ceiling from switch board to outlet for light / fan / bell /

independent plug point, in rigid steel / PVC conduit or PVC trunking as specified; fixing one board with a 1 way switch for one way point or two boards with a 2 way switch on each board, in case of 2 way point; for controlling power supply and one board / block with accessory for outlet of light / fan / plug and terminating wires within as per approved Method of Construction; removing all debris and testing the installation for safety and beneficial use.

**Material:**

Point wiring (Surface)

**PVC conduit:**

PVC pipe of minimum 20mm dia and above depending No. of wires to be drawn (refer Table No 1/2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

**PVC Trunking:**

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8 mm thick push-fit joints / accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

**Rigid Steel conduit:**

Rigid steel screwed conduit minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ISI mark, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as 5mm thick 20mm width spacers and G.I. saddles for individual pipe or GI strip for bunch of pipes, sockets, inspection type or normal; open bends, junction boxes of required ways all of the same make.

**Wires:** Phase and Neutral

PVC insulated wires of specified size, 1.1 kV, & minimum FR grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

**Earth Wire:** PVC insulated minimum FR grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, 2.5 Sqmm or bare copper wire of 14g.

**Accessories:**

**Switch:** 1 or 2 way Piano type 6/10 A, 1 or 2 way Modular type switch 6/10A.

**Outlet:** 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain three way connector or if plug point, 6A, 3-pin plug socket.

**Boards:** Switchboards shall be double walled (back and front) of suitable size, to accommodate independent slot for each switch, socket, fan regulator. Boards shall be made up of 4mm thick marine grade plywood for back and front fixed on wooden frame with 0.8mm thick laminate pasted on exposed portion of front ply, totally varnished and with either brass hinged door or screwed top.

Or

As above with 3mm thick Bakelite/Hylam top instead of laminated front ply.

Or

Board made from Filled polypropylene.

Round/Square double wooden block or PVC board for mounting light / fan outlet accessory.

**Hardware:**

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc

**16.REMOVAL OF ELECTRICAL ACCESSORIES:**

The existing electrical accessories such as switch gears, point wiring, mains, sub mains, cables, fixtures, pumps, poles, panels etc. shall be removed without damaging the accessories, walls, ceilings etc. in neat manner with good workmanship. The holes/patches etc. shall be made good and painted to match surrounding surface. Dust and dirt sprayed due to work of removal/ re fixing shall be removed and the premises shall be cleaned properly. The removed material shall be handed over to the MDL as it is.