

**PARTICULAR SPECIFICATIONS  
(ARCHITECTURAL, SITE DEVELOPMENT  
AND MEP WORKS)**

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**SECTION-VII-G****EMPLOYER'S REQUIREMENTS – ARCHITECTURAL AND SITE DEVELOPMENT****1. GENERAL**

- 1.1 The specifications for the architectural works shall be read in conjunction with other sections of these specifications and other tender documents for this Contract, in addition to CPWD Specification 2019 and approvals, instructions given by the Engineer. The general requirements are described in Section 01 herein.
- 1.2 All proprietary material shall be of approved make and the type as stipulated. Lists of approved makes are given at the end of this book. It will be deemed that the contractor has priced the respective items on the basis of those approved makes. However, it shall be the prerogative of the owner to choose any particular make among the list as the most appropriate one and the contractor shall be bound to provide the same without any variation in the contract rate. The guarantees for various architectural finishes shall be stipulated under clause 1.5 of Special Specifications for this Contract.
- 1.3 The Contractor shall submit a comprehensive list of all proprietary articles and materials used in the works containing catalogue reference numbers, colour shades, etc. and the manufacturer's and or supplier's names, addresses and where appropriate, suppliers' names and addresses including a price list CIF to the site of works. This list in approved format shall be complete in all respects and shall be submitted together with the 'As-Built' drawings and operation and maintenance manuals.

**2. LIST OF TEST MATERIALS**

Material	Name of the test	Field/ laboratory test	Min. Quantity of material required	Frequency of test/ sampling
Brick / Tile bricks/ Concrete block/ Aerocon Block	a. Efflorescence b. Water absorption c. Compressive Strength d. Dimensional Tolerance	a. Field b. Laboratory c. Laboratory d. Field	As desired by the Engineer - - 50,000 nos. as required by the Engineer.	20 bricks chosen at random for every 100,000 bricks for each brickfield.
Timber	a. Moisture content (Oven drying method) b. Species	Laboratory  Field	1 Cum  As reqd. by the Engineer.	From each fresh lot or each 10 cum material one sample.
Flush shutters/ Plywood	Test for end immersion Test for glue adhesion	Laboratory Laboratory	11 Shutters As reqd. by the Engineer	
Flooring	Test for abrasion Hardening compound	- do - - do -	- do - - do -	
Vitrified Tiles	a) Shape & Dimension b) Transverse strength c) Resistance to wear d) Water absorption	- do - - do - - do - - do -	- do - - do - - do - - do -	12 Nos./2000 nos. 6 nos./2000 nos. 6 nos./2000 nos. 8 nos./2000 nos.
Glazed tiles	a) Water absorption b) Impact test	- do - - do -	3000 nos. As decided by the Engineer.	* *
Granite marble	Hardness test	- do -	- do -	*
Fire Doors	Fire test	Laboratory tested at CBRI	Specified fire rated.	1 Door selected randomly at site.
Steel doors	a) Thickness of steel b) Sheets	Field/Lab. - do -	As specified. do -	1 Door
Aluminium	Composition of Aluminium. Alloy b) Powder coating	Laboratory  Field	As required by the Engineer	1 Sample

\* To be decided by the Engineer or his representative in accordance with site conditions.

- 2.1 Major items of work for which samples and mock-ups shall be produced by the Contractor free of cost for approval by the Engineer-in-charge.

S. No	Particulars of item	Details of sample
1.	All Marble, kotah stone and granite stone, sand stone and all other stone flooring, copings	30cm x 30cm size sample and mock-up of each type showing edge rounding, polishing, flamed textures, etc.
2.	Mirror, Glass	15cm x 15cm size sample
3.	Aluminium doors/windows, glazing	Complete assembly including anodizing/powder coating/EPDM gaskets/accessories/sealants
4.	Hardware	Complete set of each type
5.	Wall claddings stones	Samples of 2m x 2m of each type of finish including cramps, etc.
6.	Vacuum dewatering system floor	One complete mock-up as required by Engineer in charge
7.	Paints	All types in various shades and sizes, as directed
8.	Stone flooring, Vitrified tile with pattern	1m x 1m approx. laid sample
9.	Waterproofing treatment	Specialised agency and waterproofing system to be approved by Engineer-In-charge
10.	Door frame and shutters	Mock-up of each assembly of each type
11.	Stone/ceramic jali and screen wall	Sample and mock-up of each type
12.	Roofing	Sample and mock-up of each system
13.	False floor	Sample and mock-up of each system
14.	Ceramic tiles on floors	Samples and mock-ups as per the requirement of the Engineer-In-charge
15.	PVC tile flooring	Samples and mock-ups as per the requirement of the Engineer-In-charge
16.	Glass mosaic tiles and other wall tiles	Sample and mock-up 1m x 1m of each type also showing the skirting condition.
17.	Structural steel work	Mock-up of each element
18.	False ceiling (All types)	Panel of size 2m x 2m of each finish
19.	Trims and corner protections	Sample and mock-ups as per the requirement of the Engineer-In-charge
20.	All types of railings	Mock-up 2m long also showing all bends and turning conditions
21.	All types of paving	Samples and mock-ups as per the requirement of the Engineer-In-charge.
22.	All types of kerbs	Mock-ups as per the requirement of the Engineer-In-charge
23.	Copings	Mock-ups as per the requirement of the Engineer-In-Charge
24.	Insulation	Sample of glass wool insulation together with false ceiling.
25.	Fire check doors	Specialised agency and complete set including frame and accessories
26.	Metal partitions	Sample and mock-up as per requirement of the Engineer-in-Charge
27.	Treatments on expansion joints	Sample on mock-up 1m length for each type
28.	Rolling shutter	Sample of lath
29.	External finish	Mock-up of 2m x 2m of each type
30.	Any other finishing item	Mock-ups as per the requirement of the Engineer In-charge
31.	Glass blocks	Samples and mock-ups as per the requirement of the Engineer-In-charge
32.	Concrete designer Paving tiles	Samples and mock-ups as per the requirement of the Engineer-In-charge
33.	Aluminium Composite Panel	Samples and mock-ups as per the requirement of the Engineer-In-charge

### 3. MASONRY WORK

#### 3.1 Brick Work (Refer Chapter 6.0 of CPWD Specifications 2019)

##### 3.1.1 Quality



Bricks shall be of class designation 50 and conform to IS: 1077 (and its latest amendments). Bricks shall be whole, sound, well burnt, and free from cracks to ring when struck and not to crack or break when soaked in water regular in shape and uniform in size. They shall be of the best of description/class designation obtainable in the market, and of the best quality and color, and in every respect to be approved by the Engineer. Unless otherwise specified they shall be of F.P.S. Bricks of size 22.5 x 11.1 x 7.0 cm. No bricks to absorb water more than one fifth of their own weight when dry for use in load bearing walls. For bricks used in panel walls, the water absorption shall not exceed one fourth of their dry weight. Bricks to be thoroughly cleaned, well wetted, or soaked in fresh water before being used on the work, and no broken bricks to be used except as closures. Specified brick quality shall be sampled as per IS: 5454-1978 (and its latest amendments) and tested as per IS: 3495-1976 (and its latest amendments). The bricks shall meet the criteria as per IS: 1077 (and its latest amendments) tested as mentioned herein.

### 3.1.2 **Brick Bats**

Brick bats required to be used shall be obtained from well-burnt bricks.

### 3.1.3 **Dimensions**

Unless otherwise specified, they shall be of F.P.S. bricks of size 22.5 x 11.1 x 7.0 Cms.

## 3.2 **Classification**

### 3.2.1 **Compressive strength**

The bricks, when tested in accordance with the procedure laid down in Appendix B of Chapter 6 shall have a minimum average compressive strength for various classes as given in Table 6.2. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20%. In case compressive strength of any individual brick tested exceeds the upper limit specified in Table 6.2 for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified in Table 6.2 for the purpose of calculating the average compressive strength.

**CLASSIFICATION OF BRICKS**  
**Average compressive strength**  
**TABLE 6.2**

<b>Class Designation</b>	<b>Average compressive strength</b>			
	<b>Not less than</b>		<b>Less than</b>	
	<b>N/mm<sup>2</sup></b>	<b>(kgf/cm<sup>2</sup>)</b>	<b>N/mm<sup>2</sup></b>	<b>(kgf/cm<sup>2</sup>)</b>
12.5 (125)	12.5	125	15.0	150
10 (100)	10	100	12.5	125
7.5 (75)	7.5	75	10	100
5 (50)	5	50	7.5	75
3.5 (35)	3.5	35	5.0	50

### 3.2.2 **Water Absorption**

The average water absorption of bricks when tested in accordance with the procedure laid down in Appendix C of Chapter 6 of the CPWD 2019 Specifications shall be not more than 20% by weight.

### 3.2.3 **Efflorescence**

The rating of efflorescence of bricks when tested in accordance with the procedure laid down in Appendix D of Chapter 6 of the CPWD 2019 Specifications shall be not more than moderate.

**3.3 Sampling**

For carrying out compressive strength, water absorption, and efflorescence and dimensional tests, the samples of the bricks shall be taken at random according to the size of lot as given in Table 6.3 mentioned in CPWD 2019 specifications of Chapter 6 Masonry Work and samples thus taken shall be stored in a dry place until the tests are made.

Scale of Sampling and Criteria for Physical Characteristics: The lot which has been found satisfactory in respect of visual and dimensional requirements shall be next tested for physical characteristics like compressive strength, water absorption, efflorescence as specified in relevant material specification. The bricks for this purpose shall be taken at random from those already selected as per Table 6.3 above. The number of bricks to be selected for each of these characteristics shall be in accordance with relevant columns of Table 6.4 mentioned in CPWD 2019 specifications of Chapter 6 Masonry Work.

**3.3.1 Soaking of Bricks**

Bricks shall be soaked in clean water before use for a period of at least 6 hours and until air bubbles ceases to come out. The soaked bricks shall be kept on wooden plank or brick platform to avoid earth being smeared on them. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin- dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.

Note 1: The period of soaking can be easily found at site by a field test in which the bricks are soaked in water for extent of water penetration. The least period that corresponds to complete soaking will be the one to be allowed for in construction works as decided by the Engineer In charge.

Note 2: If the bricks are soaked for the required time in water that is frequently changed the soluble salt in the bricks will be leached out, and subsequently efflorescence will be reduced.

**3.4 Mortar**

All brickwork shall be laid with specified mortar to be prepared in specified proportion described in the relevant items of Schedule of Quantities. It shall be of cement and coarse sand and shall be made in small quantities so as to be used up within 30 minutes. Then it shall be mixed to a sufficiently thick consistency as required by the Engineer. No left over mortar shall be used. The proportion to be used shall be as specified in the relevant items.

**3.5 Laying****3.5.1 General**

Brickwork shall be carried out as per IS: 2212 (and its latest amendments). Bricks shall be laid in English bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. Closers in such cases shall be cut to the required size and used near the ends of the wall. Header bond shall be used preferably in all courses in curved plan for ensuring better alignment.

- a) All loose materials, dirt and set lumps of mortar which may be lying over the surface on which brick work is to be freshly started, shall be removed with a wire brush and surface wetted. Bricks shall be laid on a full bed of mortar when laying each brick shall be properly wetted and set in position by gently pressing with the handle of a trowel. It's inside face shall be buttered with mortar before the next brick is laid and pressed against it. Joints shall be fully filled and packed with mortar such that no hollow spaces are left inside the joints.
- b) The walls shall be taken up truly in plumb or true to the required batter where specified. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Each course shall be perfectly straight horizontally and transverse. The walls shall be taken up truly in plumb, if battered, the batter is to be truly maintained. The plumb of the brickwork in vertical walls shall be checked up at one metre interval. The bricks shall be laid with frogs upward. While laying brick shall be roughly

bedded and flush in mortar and tapped into position with a wooden mallet and the superfluous mortar is removed.

- c) Care shall be taken to keep the perpend properly aligned within following maximum permissible tolerances : (a) Deviation from vertical within a storey shall not exceed 6 mm per 3 m height. (b) Deviation in verticality in total height of any wall of building more than one storey in height shall not exceed 12.5 mm. (c) Deviation from position shown on plan of any brick work shall not exceed 12.5 mm. (d) Relative displacement between load bearing wall in adjacent storeys intended to be vertical alignments shall not exceed 6 mm. (e) A set of tools comprising of wooden straight edge, masonic spirit levels, square, 1 metre rule line and plumb shall be kept on the site of work for every 3 masons for proper check during the progress of work.
- d) The brickwork shall be built in uniform layers. No part of the wall during its construction shall raise more than one metre above the general construction level.
- e) Top courses of all plinths, parapets, steps and top of walls below floor and roof slabs shall be laid with brick on edge, unless specified otherwise.
- f) Bricks shall be laid with frog (where provided) up. However, when top course is exposed, bricks shall be laid with frog down. For the bricks to be laid with frog down, the frog shall be filled with mortar before placing the brick in position.
- g) To facilitate taking service lines later without excessive cutting of completed work, sleeves (to be paid separately) shall be provided, where specified, while raising the brick work. Such sleeves in external walls shall be sloped down outward so as to avoid passage of water inside.
- h) Top of the brickwork in coping and sills in external walls shall be slightly tilted. Where brick coping and sills are projecting beyond the face of the wall, drip course/throating (to be paid separately) shall be provided where indicated
- i) Care shall be taken during construction that edges of jambs, sills and projections are not damaged in case of rain. New built work shall be covered with gunny bags or tarpaulin so as to prevent the mortar from being washed away. Damage, if any, shall be made good to the satisfaction of the Engineer-in-Charge. All holes and openings left in brickwork shall be closed as directed by the Engineer.

### 3.5.2 **Raking back of Walls at angle**

Walls of all structures shall be carried up regularly in all cases, leaving no part, one metre lower than another. If this cannot be adhered to, the brick work shall be racked back at an angle not more than 45 degrees so as to maintain a uniform and effectual bond, but raking back should not start within 60 centimetre of a corner. Toothing shall not be permitted as an alternative to raking back. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

### 3.5.3 **Buttresses, Counter Forts etc.**

In all cases returns, buttresses, counter forts etc., are to built up course by course carefully bound into main walls.

### 3.5.4 **Junctions of Walls**

At all angles forming the junction of any two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brickwork shall not be raised more than 14 courses per day.

### 3.5.5 **Joints and Finishing of Joints**

Joints shall be restricted to 1.0 cms for brickwork with bricks of any class designation (unless any wider vertical joints up to 10 mm are necessary to give the required thickness of the wall). All bed joints shall be normal to that pressure upon them i.e. horizontal in vertical walls, radial in arches and at right angles to the face in battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all joints are fully filled with mortar (proportion as specified in bill of quantities) well flushed up and in case where struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely racked out to a

depth of 12 mm while the mortar is still green. The raked joints shall be well brushed to remove loose particles. After the work, the faces of the brickwork shall be cleaned with wire brush so as to remove any splash or mortar during the course of raising the brickwork. Before joining the brick work with new brickwork, old bricks surface shall be raked brushed, cleaned and soaked with water.

### 3.5.6 **Fixtures to be Provided**

All iron fixtures, pipes, conduits, drains, sleeves, bolts, holdfasts, of doors and windows and other inserts of services and all other trades of works etc., which are required to be built in walls, shall be embedded in cement mortar 1:3 (1cement: 3 sand) or in cement concrete 1:3:6 (1cement :3 sand: 6 coarse aggregate) as per requirements to suit site conditions in their correct position as the work proceeds. All brick works shall be provided with seismic reinforcements and restrains as directed by the Engineer. The reinforcements shall be measured and paid for separately.

### 3.5.7 **Brick coping and Cut Corners**

The top courses of all plinth, parapet, steps and top wall below RCC shall be laid with bricks on edge, unless specified otherwise. Care shall be taken that the bricks forming the top courses and ends of walls are properly radiated and keyed into position.

### 3.5.8 **Protection**

Green work shall be protected from rain by suitable covering. The work shall also be suitably protected from damage, mortar dropping.

### 3.6 **Curing**

The brickwork shall be constantly kept 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 the curing period.

Brick work as it progresses shall be kept thoroughly well watered on all faces for at least 10 days after completion. Proper watering cans with nozzles must be used for this purpose. The top of brickwork shall be left flooded at the close of the day by forming fillet of mortar 40mm high round the edges of top courses and filled with water.

### 3.7 **Scaffolding**

Double scaffolding sufficiently safe and strong so as to withstand all loads likely to come upon it and having two sets of vertical supports shall be provided. When two sets of supports are not possible, the inner end of the horizontal scaffolding pole shall rest in a hole provided in the header course only. Only one header for each pole shall be left out. Such holes however shall not be allowed in pillars less than one metre in width or immediately near the skew backs of arches. such holes shall be filled up immediately after removal of scaffolding properly.

### 3.8 **Half Brick Works**

Bricks used for half brick walls shall be as specified above. It shall be laid in 1:4 cement mortar exactly in the same manner as described earlier except that all courses shall be laid with stretchers. The brickwork shall be reinforced with 2 Nos 6mm dia bar embedded at every third course for the whole length of the wall as per standard practice.

No half brick walls, panels shall be greater than 8 square metres and any side larger than 3.0m. If the panel exceed the parameters mentioned above, the bricks shall be replaced by a RCC column of its same width at 3.0m intervals, which shall be further, tied to the structure by providing 100 x 200mm continuous RCC beams at the lintel level.

### 3.9 **Hollow and solid concrete blocks**

Shall conform to the requirements of IS: 2185 (and its latest amendments). Specifications for hollow and solid concrete blocks except with regard to the mix of cement concrete and sizes of aggregates, which shall be as, indicted. Hollow blocks shall be sound, free from cracks, broken edges,

honeycombing and other defects that would interfere with the proper placing of block or impair the strength or performance of construction.

### 3.9.1 Dimensions and Tolerances

Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. They include stretcher, corner, double corner or pier, jamb, header, bull nose, and partition blocks, and concrete floor units.

Concrete block-hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions. The term 'nominal' means that the dimension includes the thickness of the mortar joint.

The nominal dimensions of concrete blocks shall, as follows:

Length	:	400, 500, or 600 mm
Height	:	200 or 100 mm
Width	:	100, 150, 200, 300 mm

In addition, blocks shall be manufactured in half-lengths of 200, 250 and 300 mm to correspond to the full length. The maximum variation in the length of the units shall be not more than +/-5mm and maximum variation in height and width of unit, not more than +/-3mm.

### 3.9.2 Classification

#### **Hollow (open and closed Cavity) concrete blocks**

The hollow (open and closed cavity) concrete blocks shall conform to the following three grades:

**Grade "A":** - These are used as load bearing units and shall have a minimum block –density of 1500 Kg/Cum These shall be manufactured for minimum average compressive strength of 3.5, 4.5, 5.5 and 7.0 N/mm<sup>2</sup> respectively at 28 days.

**Grade "B":** - These are also used as load bearing units and shall have a block density less than 1500 Kg/Cum but not less than 1000 Kg/Cum. These shall be manufactured for minimum average compressive strength of 2.0, 3.0 and 5.0 N/mm<sup>2</sup> respectively at 28 days.

**Grade "C":** - These are used as non-load bearing units and shall have a block density less than 500 Kg/Cum but not less than 1000 Kg/Cum.. These shall be manufactured for minimum average compressive strength of 1.5 N/mm<sup>2</sup> at 28 days.

**Grade "D":** - The solid concrete blocks are used as load bearing units and shall have a block density less than 1800 Kg/Cum. These shall be manufactured for minimum average compressive strengths of 4.0 and 5.0 N/mm<sup>2</sup> respectively at 28 days.

### 3.9.3 Physical Requirements

#### a. **Compressive strength**

The average crushing strength of eight blocks, when determined in accordance with IS: 2185 (and its latest amendments) shall not less than as specified in Table below

Type	Grade	Density of block Kg/CuM	Minimum average compressive strength of units N/Sq.mm.	Minimum strength of individual units N/Sq.mm
Hollow (open & closed cavity) load bearing unit	A (3.5)	Not less than	3.5	2.8
	A (4.5)	1500	4.5	3.6
	A (5.5)	Not less than 1500 but not less than 1000	5.5	4.4
	A (7.0)		7.0	5.6
	B (2.0)		2.0	1.6
	B (3.0)		3.0	2.4
	B (5.0)		5.0	4.0
Hollow (Open and closed cavity) no load bearing units	C (1.5)	Less than 1500 but not less than 1000	1.5	1.2
Solid load	D (5.0)	Not less than	5.0	4.0
Bearing Units	D (4.0)	1800	4.0	3.2

- b. **Drying Shrinkage:** The drying shrinkage of the blocks (average of three blocks), when unrestrained, shall be determined in accordance with IS: 2185 and shall not be exceed 0.1 per cent.
- c. **Moisture Movement:** The moisture movement (average of three blocks) when determined in the manner described in IS: 2185 shall not exceed 0.09 per cent.
- d. **Water Absorption:** The water absorption (average of three blocks) when determined in the manner described in IS: 2185 shall not be more than 10 per cent by mass.
- e. Face shells and webs shall increase in thickness from the bottom to the top of the unit. Depending upon the core moulded, used, the face shells and webs shall flare and tapered or straight tapered, the former providing a wider surface for mortar.
- f. Subject to the tolerances specified in 2.9.1 the faces of masonry units shall be flat and rectangular, opposite face shall be parallel, and all arises shall be square. The bedding surfaces shall right angles to the faces of the blocks.
- g. Blocks with special faces shall be manufactured and supplied as directed by the Engineer in charge.

#### 3.9.4 Sampling and Testing

The sampling and testing criteria for conformity of blocks for shall be done as per IS 2185 Part-I (and its latest amendments). The manufacturer shall certify that the masonry units conform to the requirements of this specification and, if requested, shall supply a certificate to this effect to the contractor or his representative.

If Engineer in charge or his representative requires independent tests, the sample shall be taken before or immediately after delivery, at the option of the purchaser or his representative and the tests shall be carried out in accordance with the specification of IS 2185 Part-I with no extra cost.

#### 3.9.5 Marking

Concrete masonry units manufactured in accordance with this specification shall be marked permanently with the following information:

- a) The identification of the manufacturer;
- b) The grade of the unit; and
- c) The year of manufacture, if required by the purchaser.

#### 3.9.6 Curing and Drying

The blocks shall be cured in an immersion tank or in a curing yard and shall be kept continuously moist for at least 14 days. When the blocks are being cured in an immersion tank, the water of tank shall be changed at least every four days.

After curing, the blocks shall be dried in shade before being used on the work. They shall be stacked with voids horizontal to facilitate through passages of air. The blocks shall be allowed to complete their initial shrinkage before they are laid in wall.

### 3.9.7 **Construction of Masonry**

For single storeyed buildings, the hollow of blocks in foundations and basement masonry shall be filled up with sand and only the top foundation course shall be of solid blocks. But for two or more storied buildings, solid concrete blocks shall be used in foundation courses, plinth, and basement wall, unless otherwise indicated. If hollow blocks are used, their hollows shall be filled up with cement concrete 1:3:6 using 12.5mm nominal size aggregates.

### 3.9.8 **Wetting of Blocks**

Blocks need not be wetted before or during lying in the walls. In case the climate conditions so require, the top and the sides of the blocks may only be slightly moisturised so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar.

### 3.9.9 **Laying**

Blocks shall be laid in mortar, as indicated and thoroughly bedded in mortar, spread over the entire top surface of the previous course of blocks to a uniform layer of not less than 10mm and not more than 12mm in thickness.

All courses shall be laid truly horizontal, and all vertical joints made truly vertical. Blocks shall break joints with those above and below for not less than quarter of their length. Precast half-length closures (and not cut from full size blocks) shall be used. For battered faces, bedding shall be at right angles to the face unless otherwise directed. Care shall be taken during the construction to see that edges of blocks are not damaged.

### 3.9.10 **Provisions for Door and window frames**

A course of solid concrete block masonry shall be provided under door and window openings (or a 10 cms thick precast concrete sill block under windows). The solid course shall extend for at least 20 cms beyond the opening on either side. For Jambs of very large doors and windows either solid units are used, or the follows shall be filled in with concrete mix of 1:3:6 using 12.5 mm nominal size aggregates.

### 3.9.11 **Provisions for Roof**

The course immediately below the roof slabs shall be built with solid blocks. The top of the roof course shall be finished smooth with a layer of cement and coarse sand mortar 1:3, 10mm thick and covered with a thick coat of white wash or crude oil, to ensure free movement of slab.

### 3.9.12 **Intersecting walls**

When two walls meet or intersect and the courses are to be laid up at the same time, a true masonry bond between at least 50% of the units at the intersection is necessary. When such intersecting walls are laid up separately, pockets with 20 mm maximum vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these pockets.

### 3.9.13 **Piers**

The top course of block in the pier shall be built in solid blocks. Hollow concrete blocks shall not be used for isolated piers, unless their hollow is specified to be filled with cement concrete.

Fixtures, fittings, etc., shall be built into the masonry in cement and coarse sand mortar 1:3 while laying the blocks where possible. Hold fasts shall be built into the joints of the masonry during lying.

Holes, chases, sleeves, openings, etc., of the required size and shape shall be formed in the masonry with special blocks while laying, for fixing pipes, service lines, passage of water etc., After service lines, pipes etc., are fixed, voids, left, if any, shall be filled up with cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate 20mm nominal size) and neatly finished.

**3.9.14 Finishes**

Rendering shall not be done to the walls when walls are wet. Joints for plastering or pointing as specified shall be raked to a depth of 12mm.

Joints on internal faces, unless otherwise indicated, shall be raked for plastering. If the internal faces of masonry are not to be plastered the joints shall be finished flush as the work proceeds or pointed flush where so indicated.

For other details please refer CPWD 2019 specification.

**3.10 Aerocon Blocks (Refer 6.14 of CPWD 2019 Specifications)****3.10.1 Aerocon Blocks**

Shall conform to the requirements of IS: 2185 (part –III) 1984 for Specifications of AAC, IS 6041, 1985 (Reaffirmed 1990) Code of practice for construction of AAC block masonry and IS: 6441, 1072 (Part 1 to 4): Method of testing for AAC products. Aerocon blocks shall have a minimum compressive strength of 3N/mm<sup>2</sup>, the normal dry density shall be in range of 551-600 Kg/m<sup>3</sup>. Aerocon blocks should be appropriate for desired fire safety as required by Engineer. Aerocon blocks must have precise edges and shape.

**Technical Data**

S. No.	Density in oven dry condition (Kg/m <sup>2</sup> )	Compressive Strength (Min)		Thermal Condition in Air dry condition (W/m.k)
		Grade-I (N/mm <sup>2</sup> )	Grade-II (N/mm <sup>2</sup> )	
1	451 to 550	2.00	1.50	0.21
2	551 to 650	4.00	3.00	0.24
3	651 to 750	5.00	4.00	0.30
4	751 to 850	6.00	5.00	0.37
5	851 to 1000	7.00	6.00	0.42

\* Other thickness can be given on request.

\*\* Conforming to IS 2185 (Part 3), 1985- grade 2

\*\*\* Depends upon thickness.

**3.10.2 Laying**

The laying procedure is to be carried out as per the manufacturer's specifications and directions using specified cement mortar proportion. The whole work is to be carried out as per the instructions of the Engineer in charge.

**4. WOOD WORK****4.1 Scope of Work**

4.1.1 The work shall include providing wood work for the building for doors/windows, including rough grounds, access panels in suspended ceilings, skirting's, partitions and panelling, sills, counters, handrail, etc., and at any other location and situation as directed by the Engineer, including providing and installation of the hardware/ironmongery complete with finishing, including glazing work in accordance with the design, patterns, shapes, thickness, details all as shown on the approved drawings or as specified or as directed by the Engineer complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer. The work shall also include kiln seasoning, impregnation with preservatives and providing all plant, equipment and appliances required to complete the work.

4.1.2 The Contractor shall provide all the necessary wood working plant and equipment for use at site for sawing, planning, sanding, rebating, moulding, groove cutting, dovetailing, etc.



**4.2 Materials****4.2.1 Plywood and Block Board****4.2.1.1** *In addition to the Clauses of 9.2.2 and 9.2.5 of CPWD Specifications 2019 add the following:*

"Plywood shall be first quality, straight grained, light coloured with decorative teak ply, duroply (green marked) or approved equivalent and shall conform to IS: 1328. Plywood shall be BWR Grade. Block board shall be Grade I exterior grade."

**4.2.1.2** *One sample for every 100 sqm or part thereof shall be taken and testing done as per IS:303. All the samples tested shall meet the requirement of physical and mechanical properties of plywood boards as specified in Appendix D of Chapter 9 of CPWD Specifications 2019.:***4.3 Handling and Storing Materials****4.3.1** The contractor shall handle and store the materials such that any particular delivery or consignment can be identified. Incompatible materials shall be stored separately. All boards shall be stacked on a clean, dry, area so that the materials shall not come in contact with water and extreme weather conditions.

The contractor shall take steps to ensure that there is no danger of damages to the boards. The storage areas shall be clear of all other operations.

The storage, handling, lifting and transporting methods shall be subjected to the approval of the Engineer in charge.

**4.4 Shop Drawings****4.4.1** Shop drawings with full size details shall be used for execution of the work. These drawings shall be submitted to the Engineer. All work shall be carried out to the dimensions shown on the drawings. Shop drawings prepared by the Contractor shall show all details of joints, grooves, rebates, mouldings, etc., in all respects and tolerances, hardware, installation of ironmongery, etc., complete.**4.5 Architraves, Mouldings, Beadings, etc.****4.5.1** Architraves, mouldings, beadings shall be provided where called for and shall be of superior quality teakwood, true to detail (shape, size as required), clear and sharply defined. They shall be securely fastened with finishing nails, screws well set and nail holes puttied with putty coloured to match the trim.**4.5.2 Flush Doors**

In additions to clause 9.7 of CPWD specifications 2019 add the following.

All flush doors shall be Decorative Duroply (Green marked) or approved equivalent solid core type as specified to conform to IS: 2202 1991 Part -I. The finished thickness of the shutter shall be as shown on the drawings. 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. Face veneers shall be of the pattern and colour approved by the Engineer. The veneers shall be of such thickness that the core construction is not apparent when the doors are decorated. 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. An approved sample shall be deposited with the Engineer for reference.

**4.5.3** The solid core shall be prepared from best quality seasoned and treated wood, of one species, having straight grains. The adhesive used for bonding/cross-bonding and plywood, shall be Phenol Formaldehyde synthetic resin conforming to B.W.R. type specified in IS: 848.**4.5.4** All edges of the core shall be lipped internally with first class teak wood battens of 25mm minimum depth, glued and machine pressed along with the core. The lipping shall not be visible on faces. Samples for approval must have such lipping. 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. The lipping

shall not be measured and paid for separately but shall be deemed to be included in the rate for the door.

- 4.5.5 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.
- 4.5.6 Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be  $\pm 1.2$  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
- 4.5.7 Flush doors shall have appropriate construction and the depth of top/bottom rail shall be adequate to take concealed door closers/floor springs. The depth of the lock rail shall be appropriate to take the mortise locks. The Contractor shall provide mock-up to demonstrate the above, for approval, before placing order for doors.
- 4.5.8 Fixing and fittings of the Door including Wooden cleats and blocks shall be as per Clause no. 9.6.7, 9.6.8 and 9.6.9 of CPWD Specifications 2019.
- 4.5.9 No defective door shall be accepted.
- 4.5.10 Doors having other face veneers or commercial veneers shall be as specified in the Schedule of Quantities.

#### **4.6 Pre-laminated Particle Board**

- 4.6.1 In addition to clause 9.2.3 and 9.2.4 of CPWD specifications 2019 and to be further modified as follows.

Prelaminated particleboard shall be of required thickness and shall conform to IS: 12823 exterior grade (Grade – I), type II. Panels made with prelaminate particleboard will have decorative and /or balancing white laminations on one / both sides of the panel. Adhesives used for the bonding shall be BWP synthetic resin conforming to IS: 848. Edges of Prelaminated particleboard shall be sealed with water resistant paint.

#### **4.7 Plastic Laminates**

Plastic laminates shall conform to IS: 2046 and shall also satisfy surface flame spread test as per BS: 476 Part – 7. The laminates shall be 1.5mm thick, having a density of approximately 1383 kg/cum. Laminates shall be of plain matt of approved shade or textured of approved makes – Formica, Neoluxe, Bakelite Hylam or other approved equivalent.

#### **4.8 Holdfasts and Anchor Fasteners**

- 4.8.1 Holdfasts shall be as per IS: 7196. The number of holdfasts used for the doorframes shall be as approved by the Engineer.
- 4.8.2 Expansion type anchor fasteners of approved size and manufacturer shall be used in Locations where holdfasts are not allowed for fixing frames.

#### **4.9 Ironmongery**

- 4.9.1 All ironmongery shall be “Cavalier” or “Godrej” or equal approved make. Ironmongery shall be made of 316 grade stainless steel, welded, cold drawn, solution annealed and pickled tubes as per ASTM-A-249'95a. The material shall conform to chemical composition and mechanical test as per standard.
- 4.9.2 All items of ironmongery and fittings, including door locks, hinges, hydraulic door closers, floor springs, sliding mechanism for sliding doors, floor stops, latches, coat hooks, etc., together with their fixing

accessories shall be procured and fixed by the Contractor. The contractor shall supply Catalogues and samples for approval of the Engineer and shall procure the same after obtaining the written approval of the Engineer.

#### **4.10 Protection**

- 4.10.1 The Contractor shall protect the work at all times from any damage. All finished work including ironmongery shall be protected by polythene-wrap or other approved means. Doors, which are in constant use by work people, shall be kept open by means of a wedge.

### **5. STONE/GRANITE/MARBLE CLADDING WORKS**

#### **5.1 Scope of Work**

The term cladding shall mean veneering, lining, etc., and is used interchangeably with the same in this specification.

The work shall include providing stone cladding to internal and external surfaces of the building including pergolas, posts and railings, chhajjas, fascia, sides of beams/lintels/columns, soffits of slabs/beams/lintels/chhajjas, parapets, copings, balconies, sills, skirting, etc., whether to RCC or concrete or brick masonry or steel/metal all to design, patterns, shapes and thicknesses, details all as shown on the drawings or as specified or as directed by the Engineer, complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer. The work shall also include providing stone jalisi, screens, balustrades, hand railings, etc.

#### **5.2 Application Specifications**

All work shall be in accordance with the CPWD specifications 2019

Stone cladding work using stone of thickness up to 20mm shall be treated as cladding work.

The supply and installation of stone/granite/marble work shall be carried out by approved specialist agency experienced in the trade.

#### **5.3 Materials**

##### **5.3.1 Stone**

Stones shall be as specified in para 8.00 of CPWD specifications 2019. Stone shall also not contain crypt, crystalline silica or chart, mica and other deleterious materials like iron oxide, organic impurities etc.

All stones used on one face of the work shall be from the same lot and shall be of uniform colour, quality, texture and grain.

The Contractor shall provide stones to match approved samples and they shall comply with the following:

- a) Stone shall be machine cut into slabs of required thickness and to the required sizes. Hand cutting shall be permitted only for curved pieces.
- b) Stone shall be properly seasoned and brought to the proper condition for use.
- c) Each worked stone shall be marked with the natural or quarry bed.
- d) Stone shall be supplied to the work site with all shaping and matching completed at the masonry yard. The mortises, sinkings, perforations and notches for cramps, dowels and corbel plates for

supporting ribs shall be carefully of stone behind a cramp mortise shall not be less than that specified.

- e) Feature stones shall be marked for identification with drawings.
- f) Stone shall be finished, as specified, for all faces and returns etc., visible in the finished work.
- g) Stone shall be worked truly square from all face lines for the full width and thickness.
- h) The minimum thickness of stone behind a cramp mortise shall not be less than that specified.
- i) The compressive strength of common types of stones shall be as per Table – 2.1 and the percentage of water absorption shall generally not exceed 5% for stones other than specified in Tabular form hereunder:

**Table – 2.1**

<b>Type of Stone</b>	<b>Maximum Water Absorption Percentage by Weight</b>	<b>Minimum Compressive Strength kg/sqcm.</b>
Granite	0.50	1300
Lime Stone	0.15	200
Sand Stone	2.50	300
Marble	0.40	500

**Note:**

- 1. Test for compressive strength shall be carried out as laid down in IS: 1121(Part 1
- 2. Test for water absorption shall be carried out as laid down in IS: 1124.

### 5.3.2 Materials for Mortar

- a) Cement: Portland ordinary cement conforming to IS-269 and IS: 8112 shall be used. The cement shall be non-staining to the stone for cladding. The total chloride content of the cement shall not exceed 0.05%.
- b) White Cement: This shall conform to IS: 8042. The cement shall be non-staining to the stone for cladding.
- c) Sand: Crushed stone shall be used to match the stonework and shall be graded to comply with the approved sample.
- d) Coarse Sand: Shall conform to IS: 383 and shall be used for grouting of the stonework.
- e) Pigment: Shall conform to BS: 1014 or as per approved sample.
- f) Water: Shall conform to the requirements of IS: 456.

### 5.3.3 Ancillary Materials

- a) Compressible joint filler: Rigid Polyethylene foam or Rigid Polystyrene of 30 kg/cum density filler sheet or strip.
- b) Metal Fixings: Dowels, cramps, ties and other metal fixings shall be fabricated from austenitic stainless-steel sheet, strip or plate conforming to ASTM A240 Gr. 304 or bar to ASTM A479 Gr. 304.
- c) Expansion Bolts: Unless specified otherwise all expansion bolts/fasteners shall be fabricated from austenitic stainless-steel sheet, strip or plate conforming to ASTM A240 Gr. 304 or bar to ASTM A479 Gr. 304 of approved make and design. The material of the bolt shall not cause any bimetallic

corrosion with the reinforcing bars of the RCC/brickwork or with any other fixings or doors or windows or skylights etc.

#### 5.3.4 **Samples of Stone and Workmanship**

The contractor shall submit samples of the various stones, in sizes as required by the Engineer for approval. The stones shall be dressed as specified and directed by the Engineer. Decision of the Engineer in regard to the quality of the stone and workmanship shall be final and binding on the Contractor.

On approval of the sample the Contractor shall submit three samples in sizes as may be indicated by the Engineer for keeping in the sample rooms.

The Contractor shall ensure that the stone procured conforms to the approved samples.

The Contractor shall prepare samples of workmanship with stones procured in the first lot, wherein the workmanship of each stone shall be checked and approved, including workmanship of mock-up of stone cladding of various elements. The above sample work shall be to establish besides quality of workmanship, the colour of the stone/mortar, finish, lines, levels, flatness, mortar type, sealing and the like and shall also include samples of fixings, sealant, silicone water repellent application etc. for approval.

The work shall be carried out thereafter, wherein the approved mock-up shall form the minimum level of acceptable quality of workmanship.

#### 5.4 **Handling and Storing Materials**

The Contractor shall handle and store materials such that any particular delivery or consignment can be identified. Incompatible materials shall be stored separately.

All stone shall be stacked on a clean, dry, free-draining surface, be prevented from contact with soil and shall be protected from extreme weather conditions. The stone shall be covered with non-staining tarpaulins and protected from rain.

The Contractor shall take steps to ensure that there is no danger of breaking and damage to the stone. The storage areas shall be clear of all other operations.

The Contractor shall prevent damage to the stone due to handling and transport. Handling shall be planned and reduced to a minimum.

The storage, handling, lifting and transporting methods shall be subjected to the approval of the Engineer.

#### 5.5 **Dressing**

Para 8.6 of CPWD specifications 2019 shall generally be referred unless otherwise specified.

The edge of all stones at corners in junctions soffits, projecting etc. shall be fine chisel dressed with single or double rebate, as shown in the drawings or as directed. The edges of stones shall be fine chisel dressed with chamfer to form V-groove of 6mm or 8mm as shown in drawings or as directed. Machine cutting shall be resorted to instead of hand cutting for all stonework.

#### 5.6 **Mortar** 5.3.5 **Mix Proportions**

Mortar for bedding and jointing work shall be made of 1 white cement with pigment (to give desired shade): 2 sand whereas for the grout/backing it shall be made of 1 cement (grey): 3 coarse sand or as

specified in the Schedule of Quantities. Only one type of mortar shall be used for any one type of work. The proportions shall be adjusted to suit the sand.

**5.3.6 Measuring and Mixing Mortar**

The materials shall be measured in separate gauge boxes. Mortar shall be mixed by machines. The materials shall be mixed sufficiently to obtain a uniform colour and consistency and to produce consistent batches of mortar. Water shall be added to produce mortar of desired workability.

**5.7 Preparation for Stone Cladding Work**

During the preparation for the stone cladding work the Contractor shall consider the building as a whole while planning, detailing etc. and not treat any face or part thereof in isolation.

**5.8 Matching Grains and Colour**

All stone shall be sorted for colour and grains before laying. The matching of grains/colour shall be carried out as approved by the Engineer. No variation of type of grain or colour shall be allowed in any one area.

**5.9 Design and Pattern**

All work shall be laid as per design, detail, pattern, colours, sizes and dimensions given on the drawings. Any modifications and variations at site shall be reflected in adjustment in design as per the approval of the Engineer. All junctions, rebates, nosings, corners shall have square, curved or shaped mounting as desired and as shown on the drawings.

**5.10 Service and Other Outlets**

Before any work is to be taken up, the sizes and the pattern of stones shall be laid out, together with the location of electrical, sanitary outlets and those of all other services and approval sought from the Engineer. Thereafter the stones shall be laid out on the floor showing pattern of grain, etc. and work shall only be carried out after obtaining approval of the Engineer.

**5.11 Setting out**

The Contractor shall set out the stone cladding work so as to achieve the following:

- a) Establish a benchmark or datum at each floor level for setting out.
- b) Establish a vertical centre line in each plain area.
- c) Establish the positions of movement joints.
- d) Avoid or minimise unsightly cutting.
- e) Obtain truly horizontal joint lines.
- f) Where openings and other features occur the work shall be done as per the detailed drawings or as directed by the Engineer.

**5.12 Laying, Jointing and Grouting**

The requirements given under para 8.6 of CPWD specifications 2019 to be superseded. It shall be superseded by the requirements given hereunder. The term laying shall be construed to include bedding where applicable.

**5.13 Preliminary**

- a) The Contractor shall undertake everything necessary to obtain a satisfactory bond between the backgrounds, backings and finishing / cladding. Such work shall include but not be limited to the following:
- b) Withholding application until curing and drying shrinkage of the structural backgrounds are achieved.
- c) Fungicidal wash as approved to remove any organic growth.
- d) Removal of any greasy deposits by scrubbing with water and approved detergent.
- e) Final brushing to remove laitance, efflorescence or loose material.
- f) Wetting to reduce suction or to obtain uniformity of suction.
- g) On hard smooth surfaces (such as high grade concrete) or other surfaces presenting an inadequate key, an adhesive of approved make and brand shall be applied as desired by Engineer in charge. The adhesive shall be applied by spraying and a thin coat of rendering done while the adhesive is still tacky. The provision of the bonding coat shall be deemed to be included in the rate for stonework.

**5.14 Laying**

The stone cladding shall be conducted as follows:

- a) All stones and all jointing surfaces shall be made perfectly clean and free of dirt, dust, grease or other deleterious material.
- b) The stones shall be soaked in clean water for at least 30 minutes.
- c) The rendering shall be damped just sufficiently to prevent excessive water absorption from stones.
- d) The bedding surfaces of small units shall be well wetted and the units stood on a full bed of mortar and tapped home.
- e) For every large or heavy units, a mortar bed shall be screeded level and full but kept back 20mm from the face, before the stone is lowered into place. All joints shall be as completely filled as possible.
- f) Only sufficient mortar shall be spread to bed each stone.
- g) It shall be ensured that there are no hard lumps in the mortar that could prevent even bedding.
- h) Spacer dabs: Spacer dabs of appropriate mortar, or, for linings only, Plaster of Paris, can be used to achieve resistance against inward movement of the stones and shall be of such consistency and size that they will be in permanent contact with the back of the stone cladding and the structure. It is essential that they do not bridge movement joints.
- i) It shall be ensured that stones are flat and true by means of a straightedge. Adjustments if necessary shall be made within 10 minutes of fixing.
- j) "V" groove of 3 to 5 mm is to be provided as per drawings.

**5.15 Jointing**

The stone shall be fixed with consistent joint width by correct use of spacer lugs so as to provide hairline (maximum 1 mm thick) joints.

All joints shall be filled solid with 1:2 mortar (1 white cement with pigment: 2 sand) except for projecting members of overhanging cornices, which may be provided with hollow bedding where approved by the Engineer. Excess mortar shall be cleaned off immediately so that no mortar is visible on the face of the stone cladding. The stone cladding shall be properly cured for at least 7 days.

All stones shall be secured to the backing by means of stainless steel cramps, pins, anchors, fasteners and expansion bolts as shown on the "Good for Construction" drawings and approved shop drawings and as directed by the Engineer.

All cramps, dowels etc. shall be fitted and grouted solid as the work proceeds. The fixings shall be secured to concrete backings using expansion fasteners and bolts.

No stone shall bridge the expansion / separation gap provided in the structure.

#### 5.16 Grouting

The stone joints shall be grouted as follows using 1:3 mortar (1 grey cement: 3 sand) mixed with an approved bonding agent in the proportion as recommended by the manufacturer / as instructed by the Engineer.

- Grouting shall be done at any time after the stones are firmly fixed but before any dirt or contamination can enter the joints.
- Grouting materials shall be mixed to correct consistency and applied to as large an area as can be worked before hardening commences.
- The grout shall be worked well into the joints / gaps between the stone and the backing until they are completely filled.
- When the grout has set, the surplus material shall be removed and the joints tooled to required profile. When the grout has hardened the stones shall be washed down with water and finally rubbed with a gunny cloth.

If any hollow grounding is detected by tapping the stones, these shall be taken out and re-laid.

#### 5.17 Attachments / Fixings

The Contractor shall ensure that the number of fixings is in accordance with the specifications, drawings and directions of the Engineer, and that the fixings are properly made.

Over tightening and bending of fixings to accommodate inaccuracies shall not be allowed.

Each vertical unit shall be secured with two supports cum restraint purpose fixings and two restraint purpose fixings plus two pins. Each soffit unit shall be secured with four supports cum restraint fixings or as approved.

The accidental size of a cramp shall not be less than 25mm x 6mm and the pins used for securing adjacent stones shall not be less than 75mm long and 6mm diameter or as approved.

The minimum thickness of stone behind a cramp mortise shall be 20mm and the minimum depth of slot for a corbel plate shall also be 20mm or as approved.

The minimum depth of the expansion bolt to be considered for effective penetration shall be as given in Table below:

**Table – 2.2**

Type of Fixing	Structural backing material	
	Concrete	Brickwork
Load bearing	75mm	100mm
Soffit	75mm	100mm
Restraint	75mm	100mm

#### 5.18 Movement Joints

A clear 10mm wide horizontal joint may be provided at every floor level as shown on the “Good for Construction” drawings. The joints shall be formed using a shelf type stainless steel channel shaped or Z-shaped load bearing fixing. An approved sealant shall be provided in the movement joints. The joint for sealants shall be clean, dry rectangular and formed by means of a removable fillet (such as a



premoulded joint filler) for the depth of the stone cladding and backing. The joint shall be later duly sealed after cleaning, drying and placing backing material. The treatment for the horizontal and vertical separation/expansion joints shall be done in a similar manner.

## 5.19 Ancillary Work

### 5.19.1 General

#### 5.19.1.1 The Contractor shall:

- (a) Form shall chases and fixings, etc. as the work proceeds.
- (b) Temporary support or brace items liable to distortion.
- (c) Cut into masonry subject to the following:
  1. Delay cutting until the mortar has hardened.
  2. Perform cuttings in a manner that involves minimal vibration to the wall.

### 5.19.2 Sills, Copings, Chhajjas, Projecting Units

All sills, copings, chhajjas, projecting units and the like shall be provided with a rebate on the underside/soffit so as to provide a clean fit joint with the vertical facing stone.

All sills, copings, chhajjas, projecting units and the like shall be provided with a drip mould cut in chase on one or both sides on the underside and the exposed edge shall be finished as specified or as shown in the drawings.

### 5.19.3 Circular Columns, Circular Walls

Stone facing to circular column/walls shall be provided to match the profile of the columns/walls as specified. The height of the stone shall match that of the course shown in the drawings.

### 5.19.4 Stone Jalis/Screens/Ceramic Claustra

Stone jalis/screens/ceramic claustra shall have a finished thickness as specified in the Good for Construction Drawings. Fine chiselled on all visible surfaces with rebates, grooves etc. as per design in straight rectangular / angular arched pattern all as specified or as directed, duly secured with stainless steel attachments/cement or glue jointed / fixings to RCC, concrete, brick masonry, steelwork etc.

### 5.19.5 Balustrades and Handrails

Balustrades and handrails in rectangular and/or curved shape in plan and/or in elevation shall be fine chiseled on all visible surfaces and duly secured with stainless steel attachments / fixings to adjacent work.

## 5.20 Scaffolding

All scaffolding as required shall be provided till the completion of work.

## 5.21 Tolerance for Finished Work

The finished work shall conform to the following tolerance.

- (a) All the hairline joints shall be in perfect lines and levels.
- (b) Plumb.
  - i. In any 3m  $\pm 5\text{mm}$
  - ii. Maximum per floor  $\pm 10\text{mm}$
  - iii. Maximum for total height  $\pm 15\text{mm}$
- (c) Horizontal:
  - i. In any 3m  $\pm 5\text{mm}$
  - ii. Maximum for total length  $\pm 10\text{mm}$

## 5.22 Cleaning, Completion and Mock-up

On completion of the first area of stone cladding, once it is duly cured and dried the Engineer-in-Charge shall examine the same to ascertain whether the quality of workmanship and finish is as desired. If the

quality is accepted by the Engineer-in-Charge as the desired finish the same area shall be cleaned of all dust and other deposits by washing together with detergent or other admixtures, with the approval of the Engineer.

Upon completely drying, it shall be finished with an application of silicone water repellent solution to seal the surface. Refer specifications for silicone water repellent solution.

This area of stone work shall be retained as a sample of finished stonework, wherein the effects of weather, movement and other conditions shall be reviewed over a period not exceeding one month and the effects if found leading to unsatisfactory work, shall be remedied by the Contractor, until a satisfactory sample of finished work is accepted.

All subsequent work shall thereafter be completed to the standard and quality as approved for the above mock-up. In case any portion is not done to the desired quality the same shall be deemed to be rejected and shall be removed and replaced at no extra cost.

## **5.23 Acceptance Criteria**

### **5.23.1 Acceptance of Work at Intermediate Stage**

The work executed on any day shall be checked at the end of that day or the next day before commencement of further work. Any work found to be of acceptance quality or not in accordance with the specification should be rejected, removed and replaced before proceeding with further work.

Any stones, duly fixed, which are found to have tolerance for surface fine chisel work beyond the limits specified, may be allowed to be chiselled in place to achieve the desired quality of workmanship but acceptance shall be at the sole discretion of the Engineer. This shall not be construed as a means of correcting lines and levels of the joints.

Any stones found to have variation in colour with respect to the majority of the stonework shall be removed and replaced, before any further work is taken up.

### **5.23.2 Final Acceptance of Work**

Various stages of approval are required to be met by the Contractor. Regardless of the acceptance of work at intermediate stages, the final acceptance shall only be accorded once the entire work is complete in one area of the building; after all other works as per this Contract have also been duly completed and accepted.

The Contractor shall ensure that the stone work is so constructed that it prevents rain water from reaching its inside surface and that rainwater falling or running down its external surface does not cause permanent or significant temporary deterioration in its performances. All units and joints between units shall be designed to prevent ingress of water by capillary.

The Contractor shall ensure that the risk of attack or infestation by micro-organisms, fungi, insects and other vermin is minimal and also that there is no risk of ingress of vermin into the building.

## **5.24 Protection**

The Contractor shall protect all work until handing over. The lower courses shall be protected with heavy polyethylene sheeting, not less than 1000gm/sqm, whilst work is in progress at higher elevations. All cement slurry and droppings shall be washed off daily during work above.

## **5.25 Shop Drawings**

The shop drawings shall be prepared on the basis of the "Good for Construction" drawings issued by the Engineer. The shop drawings shall inter alia show the location and type of all attachments. Site variations shall be taken into account while preparing the shop drawings.

**5.26 Marble Works****5.26.1 Scope of Work**

The work shall include providing prepolished marble for the building in walls, columns, sills, jambs, sides of beams / lintels / columns, soffits of slabs / beams / lintels / chhajjas, façades, floors, staircases, parapets, copings, balconies, jails, skirting, counters, up stands, bands in interior / exterior works and in any other locations and situations, whether to RCC or concrete or brick masonry or steel / metal, all to design, patterns, shapes and thickness, to details as shown on the "Good for Construction" drawings or as specified or as directed by the Engineer complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer.

**5.26.2 Applicable Specifications**

All work shall be done in accordance to section 8 of CPWD specifications 2019 except as modified hereunder and as per additional requirements given hereunder.

**5.26.3 Materials**

In addition to Section 8 of CPWD Specifications 2019, add the following. For all Marble Works with the following: additional requirements / amendments

- (a) All stone shall be supplied prepolished, duly table rubbed and polished at the Contractor's work, using cutting and polishing stones of different grades (No. 60, 120, 220 and 320) and latter cleaned with oxalic acid applied at 33 mg/sqm. So as to give a plane, true and high quality mirror polished smooth, even, unwrapped surfaces with square cut edges.

In additional to the classification given in nd clause 8.1 of CPWD Specifications 2019 further classification shall be as mentioned below:

- (a) White Indo-Italian marble, selected without pista predominantly white, having light, green grain / brown grain, no blotches or pista.
  - (b) Rajnagar white, spotless white.
  - (c) Udaipur dark green marble from Khetan mines, without white spots or patches or black patches.
- All joints in marble work shall either be fit joints or with a V-Groove of 3 mm to 5mm as shown in the Good for Construction Drawings or as directed by the Engineer-in-Charge.

**5.26.4 Mortar**

The mortar used for jointing slabs shall be as specified.

**5.26.5 Preparation for Marble Work**

Preparation for marble work shall be in accordance with description of item in BOQ and approved method statement submitted by contractor.

**5.26.6 Design and Pattern**

Design and pattern shall be provided as given in the drawing or as per directions of Engineer In charge.

**5.26.7 Service and Other Outlets**

Service and other outlets shall be provided as given in the drawing or as per directions of Engineer In charge.

**5.26.8 Marble work Table Rubbed and Polished (Plain Work)****5.26.8.1 Dressing and Rubbing**

*Replace Para of clause 8.5.1 of CPWD Specifications 2019 by the following.*

- a. Every stone shall be machine cut to the required size and shape, free from waviness and to give truly vertical, horizontal, radial or circular joints as required. All visible angles and edges shall be

true, square and free from any chippings. The surfaces of the stones coming in contact with backing shall not be polished.

5.26.9 Laying

In clause 8.6.2 of CPWD Specifications 2019 add the following.

In case of light coloured stones, the back of the stone shall be buttered with white cement or white cement with pigment as required so as to enhance its appearance aesthetically.

5.26.10 Finishing

After the marble work is laid the excess mortar shall be cleaned off immediately so that no mortar is visible on the face of the marble work. Curing shall be done for seven days.

The work shall then be dusted over with oxalic acid at the rate of 33 gm/sqm. Sprinkled with water and rubbed hard with a namdah block (pad of woollen rags). The following day the marble work shall be wiped with a moist rag and dried with a soft cloth and finished clean.

5.26.11 Waxing not used

5.26.11.1 Cleaning, Completion and Mock-up - Clauses 4.22 shall apply for marble work.

5.26.12 Acceptance Criteria

Acceptance of work at intermediate stage.

Clause 4.23.1 shall apply for marble work.

The marble work shall be deemed to be acceptable only if the quality of finish desired by the Engineer is achieved. In case the prepolished work is not to be correct lines and levels the Contractor shall rectify the same by replacing the defective pieces or by repolishing the work in situ at no extra cost.

5.26.13 Final Acceptance of Work

Clause 4.23.2 shall apply for marble work.

**5.27 Marble work in Wall Lining etc. (Veneer work)**

5.27.1 **General**

All clauses given under Stonework Cladding of these specifications shall apply to Marble Veneer work also in so far as they apply to marble work in wall lining etc. (Veneer work). However, the surface finish shall be as specified or as directed by the Engineer-in-Charge.

All clauses under clause 8.6 of CPWD Specifications 2019 shall apply except for clauses 8.6.3, 8.6.6 and 8.6.7, which shall be replaced as given hereinafter.

Add the following to the clause 4.12 for laying.

- (a) In case of light coloured marble stones for veneering/cladding the back of the stone shall be buttered with white cement/white cement with pigment so as to enhance its appearance aesthetically.

5.27.2 **Joints**

Clause 8.6.3 Of CPWD Specifications 2019 shall not apply. All jointing shall be as for stonework as given in this chapter, as per drawing and directed by Engineer.

5.27.3 **Tolerances**

All work shall be done so that all the joints are hairline fit and are to perfect lines and levels. Also refer Stonework.

**5.28 Marble Stone Flooring and Marble Stones in Steps and Skirting**

All the relevant clauses under Marble Work as given above shall apply.

The allowance provided for the total thickness of the floor finish over the RCC slabs is 75mm. The base shall be screeded with concrete to make up the levels, for provision of the finishing materials and the specified thickness of mortar. The concrete screed for the base shall be measured and paid for separately.

Before commencement of flooring work all the joints of the brickwork shall be raked open to provide good key for the base coat of the plaster. Nothing extra shall be paid for raking the joints.

The thickness specified for stonework shall be with a tolerance of  $\pm 2$ mm. However, once one thickness is established or adopted the same shall be followed throughout for the rest of the work.

**5.29 Dressing**

Replace the clause 11.19.2 of CPWD Specifications 2019 by clause 4.26.9.1 of this specification.

**5.30 Laying**

Clause 11.19.3 of CPWD Specifications 2019 shall apply to the extent it is applicable to laying of prepolished marble slabs. The base mortar, comprising Portland cement and coarse sand of mix as specified or directed by the Engineer, shall be laid over the area to be tiled, well compacted and levelled. Thereafter marble shall be laid with a floating coat of white cement slurry with pigment.

In specific areas and where directed the marble shall be laid to proper slopes as shown on the drawings.

**5.31 Granite Works****5.31.1 General**

All the clauses as given under marble work shall apply except that the classification for granite shall be as given below.

- a) Red granite – Karnataka.
- b) Multi-colour granite – Andhra Pradesh
- c) Grey granite – Karnataka
- d) Blue lavender granite – Orissa
- e) Paradiso granite – Andhra Pradesh
- f) Hassan green granite – Karnataka
- g) Black granite – Karnataka
- h) Raw silk
- i) Sadharhalli
- j) Kota Stone
- k) Cuddapa
- l) Sira

**5.31.2 Finishes for Granite Work**

The finishes for granite work shall be either mirror polished, semi-polished (honed finished) or flamed as specified or as directed by the Engineer-in-Charge.

**5.31.3 Flamed finished Granite Work**

All flamed granite work shall be cleaned with a solution of oxalic acid applied at the rate of 33 gm/sqm. So as to give clear, textured and even surface.

- 5.31.4 **Waxing**  
Granite work shall not be wax polished after finishing.

- 5.31.5 **“V” grooves**  
V” grooves of 3 to 5mm shall be provided as per drawings. .

## 6 FLOORING

### 6.1 Scope of Work

The work shall include providing floor finishes for the building all as shown on the drawings or as specified or as directed by the Engineer-in-Charge complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer-in-Charge. The work shall be carried out under the supervision of the manufacturer/specialist sub-contractor who shall be appointed only after prior approval of the Engineer-in-Charge.

### 6.2 Applicable Specifications

All work shall generally be in accordance with CPWD Specifications 2019.

### 6.3 Vitrified Tiles Flooring

Refer to Clause 11.16.1 of CPWD specifications 2019.

### 6.4 Cavity Floor

**Type “A”** These shall be as made by Hewetson or approved equivalent.

#### 6.4.1 General

Flooring is laid with floor panels as specified. It shall be laid on raised framework consisting of pedestal and strings forming laid base finished evenly and smooth.

Cavity flooring shall be of approved proprietary make, fully removable, fire resistant floor system and shall be installed by an approved specialist agency.

Cavity floor shall be of modular construction having modules of panel dimension as specified/detailed in drawing. The construction method will give complete lateral restraint. There shall not be any gap in the panel joints and each panel shall be removable separately without disturbing adjacent panels. The panels shall be supported on all four edges and capable of sustaining a point load of 4.0KN on 25 sqmm on any part of the panel and uniformly distributed load of 25KN per Sqm with a deflection of not more than 2 mm. Panels will not rock on their supports and tolerances in level between top surfaces of adjacent panels shall not be more than 1 mm. The floor panels shall be leveled to a tolerance not more than 3 mm in 12.0 meters. All exposed steel parts shall be galvanized.

#### 6.4.2 Pedestal

Pedestals shall be made out of 20/25 mm dia mild steel zinc electroplated with chromate passivation welded with 100 mm x 100 mm x 8 mm thick base plate with top head attachment made out of pressure die cast zinc Aluminium alloy in shape, thickness and size as per details. The top head attachment shall be adjusted by means of check nuts movable up and down for level adjustment. The pedestal shall have level adjustment of 25 mm up and down for leveling. Pedestal shall be fixed firmly to the floor at 600 mm c/c both ways with Araldite or COACM screw.

#### 6.4.3 Supporting Frame Work

Stringers shall be of pressed cold rolled steel channel sections (zinc electroplate) with chromate passivation) and of size 40 mm x 40 mm x 3.15 mm thickness shall be of fixed on the top head attachment in both directions to form grid frame work of 600 mm x 600 mm true to level and alignment to support the false floor panels along all edges.

#### 6.4.4 Floor Panels

The floor panels will be generally square of sizes 300mm x 300mm, 600mm x 600mm or 900mm x 900mm made of 31 mm thick high density Particle Board or approved equivalent faced on top with 2 mm thick fire retarded flooring grade F.R.F.G. or approved equivalent laminate or approved Antistatic Vinyl flooring tiles as required. The floor panel will be laminated on the underside with 0.05 mm thick galvanized steel foil. The edges of panels shall have lipping of hard PVC fixed with adhesives. The finished panels shall be in perfect size, shape, alignment, free from any undulation/warping and properly numbered and directional arrow marked on the underside for identification. The floor panels and stringers shall be completely removable and shall remain in position without screwing or bolting. The joints between finished floor panels shall be airtight. The floor panels shall be suitable for cutting whenever required for providing suitable outlets for cables, etc. The panels shall be removable by pulling upward with a suction device to be provided.

## 6.4.5

**Tolerance**

- |     |                         |   |                   |
|-----|-------------------------|---|-------------------|
| (a) | Thickness               | : | $\pm 2.5$ percent |
| (b) | Width/Length            |   |                   |
|     | i. 300mm square panel   | : | $\pm 0.4$ mm      |
|     | ii. 600mm square panel  | : | $\pm 0.6$ mm      |
|     | iii. 900mm square panel | : | $\pm 0.8$ mm      |

## 6.4.6

**Laying and Fixing**

- a) Before commencing the laying operations the sub floor shall be examined for evenness. The floor shall then be cleaned with dry cloth and dryness should be attained. The concrete sub floor dryness can be determined by relevant tests as approved by Engineer.
- b) The layout of flooring should be marked on sub floor with guiding/reference lines. The flooring shall be first laid for trial, without fixing pedestals, according to the required layout.
- c) The pedestal shall be securely fixed to sub floor with raw plugs and C.P. brass screws and araldite.
- d) The channel stringers shall be placed over top head attachment of pedestal.
- e) The alignment and level should be checked after fixing of channel stringers is completed.
- f) The floor panels shall be carefully taken and placed in position from one end onwards. The panels should have very little gap between joints.

## 6.4.7

**Measurement:**

False flooring/ cavity flooring shall be measured separately and in square meter correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying. Nothing extra shall be paid for laying the floor at different levels in the same room.

## 6.4.8

**Rates:**

The rate shall include the cost of all the materials and labours involved in all the operations described as above.

## 6.5

**Cavity Floor**

**Type "B":** These shall be as made by United Insulations or approved equivalent conforming to PSA MOB standards.

**Panel:**

Unitile ® USF-1500 Access Floor panel of size 600 x 600mm shall be all steel welded construction, with an enclosed bottom pan of 49 hemispherical and 36 reverse cones and top plain sheet which are fuse welded at 124 locations to form a panel of an overall depth of 35mm. The inner empty core of the panel is injected with a light weight fire retardant noncombustible cementious compound at high pressure to fill in all the crevices of the panel and ensures support of not less than 85% of the top surface area of the panel. The panel after cleaning, degreasing, phosphating by 7-tank process is coated with 40-60 micron epoxy coat and is heated to achieve maximum adhesion and surface resistance.

The panel is then laminated with 1.5mm thick fire retardant floor grade antistatic laminate (electrical resistance shall be in the range of  $1.0 \times 10^6$  ohms to  $2.0 \times 10^9$  ohm) on a semi automate lamination line to ensure maximum bonding to the steel surface. The edge of the laminated is protected with a conductive PVC edge profile of the same range of the electrical resistivity as the laminate which is 5mm wide on all sides. This edge trim is mechanically locked and sealed in place to avoid detachment.

**Panel Loading:**

1. **Concentrated Point Load:** 680 Kgs on a 25 x 25mm square indenter on the center of the panel with a maximum permissible deflecting of not more than 2.5mm as per standards.
2. **Uniformly distributed load (UDL):** 2300 Kgs per Sqm with a maximum permissible deflection of 2.5mm as per standards.
3. **Ultimate load:** Should be more than or equal to 2640 Kgs.
4. **Rolling load:**
  - a. Wheel 1 i.e. 3" dia- 10 passes: 667 Kgs.
  - b. Wheel 2 i.e. 6" dia- 10000 passes: 556 Kgs
5. **Impact Load:** 78 Kgs.

**Fire Rating:** The panels shall confirm to Class 0 and Class 1 Fire Ratings tested as per BS 476 Part 6&7.

**Sub Structure- Pedestal Assembly:**

Sub structure installed to support the panel shall be suitable to achieve a minimum finished floor height of 65, to a maximum of 600mm from the existing floor level. Pedestals design shall confirm speedy assembly and removal for relocation and maintenance. The assembly shall provide easy adjustment of levelling and accurately align panels for a maximum of 25mm up and down in the vertical direction. The Pedestal head assembly shall consists of a 90 x 90 x 4mm head mechanically riveted to a 100mm length 19mm dia stud and 2 check nuts for level adjustments and arresting vertical movement. The pedestal head shall consists of an anti-vibration PVC cap, for Panel and stringer location. The pedestal base assembly shall consist of 25mm OD pipe of thickness 2mm projection welded to a base plate of 125 x 125 x 2.5mm thick with stiffening folds.

The sub structure assembly shall be suitably anchored to the floor with suitable adhesives of fastener as recommended by the manufacturer.

All steel components shall be electroplated.

**Axial Load:** Pedestals shall support an axial load of 2200 Kgs without permanent deflection and an ultimate load of 3500 Kgs.

**Stringers:**

The stringers are hot-hipped galvanized steel cold rolled construction specially designed for lateral stability, rolling loads and support the panels on all four sides for alignment. The stringer to have a counter sunk holes at both ends to accommodate bolting of the same to the pedestal head assembly. The top of the stringer shall be fitted with sound retardant gasket achieving noise proof and air leakage proof system. The stringers shall be 21 x 32 x 1.00mm x 570mm length.

The other specifications not mentioned here will be the same as specified in Type "A" as far as applicable.

**6.5.1 Measurement:**

False flooring/ cavity flooring shall be measured separately and in square meter correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying. Nothing extra shall be paid for laying the floor at different levels in the same room.



- 6.5.2 **Rates:**  
The rate shall include the cost of all the materials and labours involved in all the operations described as above.
- 6.6 Granolithic Flooring (Non-Metallic Hardening Compound)**
- 6.6.1 **Scope of Work**  
The scope of work is comprising of using non-metallic compound as per manufacturer's specifications to make the surface hard enough to bear abrasion, improve impermeability, resist weathering.
- The work has to be carried out as per the manufacturer's specifications. Compound to be used shall be Ashford Formula of J B Associates/Nitoflor Hardtop Standard of Fosroc or any other approved equivalent
- 6.7 Vacuum Dewatering System**
- 6.7.1 **General**  
The Contractor shall improve the quality of all concrete floor slabs by placing the concrete according to the Tremix Vacuum Dewatering System as specified herein, specifications in this document for concrete and other related work.
- 6.7.2 **Planning**  
The contractor shall submit for review shop drawings for floor slabs detailing the location of all construction joints and the sequence of the slab placement, and manufacturer's literature describing the equipment to be used. In addition to the shop drawings, the contractor shall indicate the quantity of each piece of dewatering equipment that will be located at the construction site and shall include the dimensions of all suction mats.
- Before concreting is started the work should be planned with a view to determine areas to be placed daily, the required amount of equipment, size of vacuum mats, length of vacuum hoses, arrangement of rails, if any, or screeds etc. Crew required for the vacuum process is two men to handle the mats and the pump. Note that placing, vibration, vacuum treatment and floating follow immediately behind each other.
- 6.7.3 **Equipment**  
All process equipment to be used shall be of a design representative of the state of the art, and shall be subject to the approval of the engineer. Equipment shall be Tremix or approved equal. System shall have a demonstrated five years history of performing such work. The vacuum pumps shall be able to generate a minimum number and size of suction mats required for this work.
- The contractor shall have at the job site sufficient equipment (vacuum pumps, mats, filler pads and accessories) to ensure that the vacuum dewatering process continues uninterrupted to completion.
- 6.7.4 **Operators and Workers**  
During the placement of concrete, the contractor shall have a minimum of one person present at all times who has been adequately trained by a representative of the equipment manufacturer. This person shall be experienced in the Vacuum Dewatering process, and in the operation of all related equipment and shall direct all concrete dewatering work performed.
- 6.7.5 **Quality Control**  
The contractor has the responsibility for achieving the quality of concrete specified by controlling the concrete mixes, placing, vacuum process finishing and curing. The concrete technician in charge must be present at the site when work is in progress.
- The contractor shall be responsible for mix adjustments, performing necessary tests, correcting deficiencies and trouble shooting in general. The contractor shall be required to maintain control showing individual test results for aggregate gradation. Slumps, air content, cement content and compressive strength. Data for slump; compressive strength etc. will be supplied by the engineer.

**6.7.6 Equipment Specification for Tremix System****6.7.6.1 Vibrators**

Poker vibrator with high frequency preferably Hz (20000 vibrations/min) dia 25 to 40 mm. Surface vibrator type double beam with spacing 30 cm.

Preferably one piece beam in full length exceeding bay width within 20 cm to 60 cm. Beam should easily be adjusted to absolute straightness and controlled every morning before placing of concrete starts.

**6.7.6.2 Vacuum Dewatering Equipment**

Suction mat type rm 60. 100% tight plastic material weight 650 gram/m<sup>2</sup>. Width same as bay size and length 6m for capacity and flexibility.

Filter pad type RD12 weight 600 g/m<sup>2</sup>, width 1.2 m, length=bay width-minus 20 cm.

Vacuum pump o4001 B with 10 HP engine & specially designed pump unit with heavy duty chrome housing & sealing. Adjustable vacuum by value on top of tank for ease of operation with different mix designs.

**6.7.7 Execution of Tremix System****6.7.7.1 General**

The work shall be planned and executed so that there is no delay between the placements, screeding, dewatering and floating of the concrete to be vacuum dewatered shall be handled and placed so as to prevent segregation. The concrete shall be internally vibrated prior to screeding.

**6.7.7.2 Levelling**

Immediately following placement, the concrete shall be levelled with a vibrating screed running on a true surface, set at the proper elevation required to provide the specified finished elevation. The concrete surface shall be screeded high by 2% of the slab's thickness to compensate for the compaction caused by the vacuum dewatering process. The vibrator screed shall be moved forward as rapidly as proper consolidated allows. The proper surcharge of concrete must be maintained in front of the leading edge of the screed.

**6.7.7.3 Vacuum dewatering**

Immediately after levelling, the concrete shall be covered with filter pads and suction mats in strict accordance with the recommendation of the manufacturer to have the slab fully dewatered. The suction mat shall extend 100 mm beyond the edge of the filter pad on all sides. The pads shall extend with 100 mm of the edge of concrete slab, and the mat shall cover entire slab. Before connecting the hose on the suction mat to the vacuum pump, the edges of the mat shall be smoothened to enable and airtight seal to be created. A vacuum shall then be applied to the mat.

After a minute the gauge on the vacuum pump should indicate a minimum vacuum of 0.70 atmospheres (24.0 in. Hg) and if not, the mat must be checked for leakage. For concrete that dewaterers readily the vacuum should then be maintained at 0.70 - 0.80 atmospheres (24.0 - 25.5 in.hg). for concrete which dewaterers less efficiently (e.g. air-entrained concrete) the vacuum shall then be reduced to 0.50 - 0.60 atmospheres (15.0 - 18.0 in. Hg). After approximately 10 minutes the vacuum can then be increased to 0.80 atmospheres.

The vacuum shall be maintained for at least 3 minutes per 25 mm of concrete thickness at 0.80 atmospheres. (Where) aggregate hardeners are specified, sufficient moisture shall be maintained to meet manufacturer's requirements). The suction mats and filter pads shall then be removed and moved to the next suction in a leapfrog manner.

Stop the vacuum dewatering when light footprints only are left in the concrete when stepped upon. A suitable suction time can also be checked with a Proctor-apparatus which should show 1.5 - 2 kg/cm<sup>2</sup>.

**6.7.7.4 Floating**

Upon removal of the suction mats and filter pads the concrete surface shall be power-floated without delay until all imprints from the vacuum process are removed. If crusting occurs, the floating operation must be delayed till the concrete carries the machine. The higher speed is recommended for the floating operation. To avoid cracks, two passes with the floating disc should be made in the junction of two mats.

**6.7.7.5 Finishing**

The waiting time after the floating operation depends on concrete temperature and humidity and varies from 10 minutes to 2 hours. The trowelling operation cannot take place before the concrete has hardened enough to carry the machine, i.e. the trowel ling blades will not leave any marks on the concrete. Repeated trowel ling, with intervals between the passes, which are adapted to the setting of the concrete, greatly improves the surface characteristics. The surface will be more wear resistant and less dusty.

**6.7.7.6 Inserts**

The contractors shall fix all necessary inserts such as steel plates, pipe sleeves, bolts etc. And make provision for holes pockets etc. As indicated on the drawings or as required by the Architect.

**6.7.8 Curing**

Vacuum dewatered concrete should be cured like any other quality concrete in order to achieve a good final result. Use curing compounds, plastic sheets or wet burlap.

**6.7.9 Measurements**

Measurements shall be done in square meter in accordance with the mode of measurements as specified in IS: 1200.

**6.8 Specifications for Cement Concrete Flooring**

Generally, all works shall be done in accordance with section 11.2 of CPWD Specifications 2019.

**6.8.1 Cement concrete**

Cement concrete of specified mix shall be used and it shall generally conform to the specifications described in relevant section.

**6.8.2 Base concrete**

Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slopes required for the flooring. Flooring in verandah courtyard kitchens & baths shall have slope ranging from 1: 48 to 1: 60 depending upon location and as decided by the engineer. Floors in water closet portion shall have slope of 1: 30 or as decided by the engineer to drain off washing water. Plinth masonry off set shall be depressed so as to allow the base concrete to rest on it.

If the base is of lean cement concrete, the flooring shall be commenced preferably within 48 hours of the laying of base concrete. The surface of the base shall be roughened with steel wire brushes without disturbing the concrete. Immediately before laying the flooring, the base shall be wetted and a coat of cement slurry at 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

If the cement concrete flooring is to be laid directly on the RCC slab, the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry at 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

**6.8.3 Thickness - The thickness of floor shall be as specified in the description of the item.****6.8.4 Laying**

Panels - Flooring of specified thickness shall be laid in the pattern including the border/ or as given in the drawings or as directed by the engineer. The border panels shall not exceed 450 mm in width and

the joints in the border in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 m and the area of a panel shall not be more than 2 sqm.

Laying of flooring with strips - Normally cement concrete flooring shall be laid in one operation using glass / plain asbestos/ aluminium/PVC / brass strips or any other strips as required as per drawing or instructions of the engineer, at the junction of two panels. This method ensures uniformity in colour of all the panels and straightness at the junctions of the panels. 4 mm thick glass strips or 5 mm thick plain asbestos sheet, 2 mm PVC strips or 2 mm aluminium or brass strips, shall be fixed with their tops at proper level, giving required slopes.

Concreting - Cement concrete shall be placed in the panels and be levelled with the help of straight edge and trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge and made true to required slopes. While laying concrete, care shall be taken to see that the strips are not damaged/disturbed by the labourers. The tops of strips shall be visible clearly after finishing with cement slurry.

Laying of flooring without strips

Laying of cement concrete flooring in alternate panels may be allowed by the engineer in case strips are not to be provided.

Shuttering - The panels shall be bounded by angle iron or flats. The angle iron/flat shall have the same depth as the concrete flooring. These shall be fixed in position, with their top at proper level giving required slopes. The surface of the angle iron or flats, to come in contact with concrete shall be smeared with soap solution or non-sticking oil (Form oil or raw linseed oil) before concreting. The flooring shall butt against the unplastered masonry wall.

Concreting - The concreting shall be done in the manner as described. The angle iron / flats used for shuttering shall be removed on the next day of the laying of cement concrete. The ends thus exposed shall be repaired, if damaged with cement mortar 1: 2 (1 cement 2 coarse sand) and allowed to set for minimum period of 24 hours. The alternate panels shall then be cleaned of dust, mortar, droppings etc. and concrete laid. While laying concrete, care shall be taken to see that the edges of the previously laid panels are not damaged and fresh mortar is not splashed over them. The joints between the panels should come out as fine straight lines.

#### 6.8.5 **Finishing**

The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided.

Fresh cement shall be mixed with water to form thick slurry and spread at the rate of 2 kg of cement over an area of one sqm of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth.

The edges of sunken floors shall be finished and rounded with cement mortar 12 (1 cement 2 coarse sand) and finished with a floating coat of neat cement.

The junctions of floor with wall plaster, dado or skirting shall be rounded off where so specified.

The men engaged on finishing operations shall be provided with raised wooden platform to sit on so as to prevent damage to new work.

**6.8.6 Curing**

The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

**6.8.7 Precautions**

During cold weather, concreting shall not be done when the temperature falls below 4 degree Celsius. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall be taken to see that the temperature of wet concrete does not exceed 35 degree Celsius. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the engineer. To facilitate rounding of junction of skirting, dado and floor, the skirting / dado shall be laid along with the border or adjacent panels of floor.

**6.8.8 Measurement**

Length and breadth shall be measured before laying skirting dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.

The flooring done either with strips (in one operation) or without strips (in alternate panels) shall be treated as same and measured together.

**6.8.9 Rate**

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

**6.9 Specifications for Cement Plaster in Risers of Steps, Skirting, Dado**

Generally all works shall be done in accordance with section 11.4 of CPWD Specifications 2019.

**6.9.1** A band of plaster at the bottom of wall not exceeding 30 cm in height above the floor shall be classified as skirting. It shall be flush with wall plaster or projecting out uniformly by 6 mm from the wall plaster, as specified. The work shall be preferably carried out simultaneously with the laying of floor. Its corners and junctions with floor shall be finished neatly as specified.

**6.9.2** Thickness - The thickness of the plaster specified shall be measured exclusive of the thickness of key i.e., grooves or open joints in brick work. The average thickness shall not be less than the specified thickness. The average thickness should be regulated at the time of plastering by keeping suitable thickness of the gauges. Extra thickness required in rounding of corners at junctions of wall shall be ignored.

**6.9.3** Preparation of wall surface - The joints shall be raked out to a depth of at least 15 mm in masonry walls. In case of concrete walls, the surfaces shall be roughened by hacking. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

**6.9.4** Application - Skirting with specified mortar and to specified thickness shall be laid immediately after the surface is prepared. It shall be laid along with the border or adjacent panels of floor. The joints in skirting shall be kept true and straight in continuation of the line of joints in borders or adjacent panels. The skirting shall be finished smooth and true, with top truly horizontal and joints truly vertical except where otherwise indicated.

- 6.9.5 Finishing - The finishing of surface shall be done simultaneously with the borders of the adjacent panels of floor. The cement to be applied in the form of slurry for smooth finishing shall be at the rate of 2 kg of cement per litre of water applied over an area of 1 sqm.

Where skirting is flush with plaster, a groove 10 mm wide and up to 5 mm deep shall be provided in plaster at the junction of skirting with plaster. Curing - Curing shall be commenced on the next day of plastering when the plaster has hardened sufficiently and shall be continued for a minimum period of 7 days.

- 6.9.6 Measurement - Length and height shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimals stating the thickness. Length shall be measured as the finished length of skirting. Height shall be measured from the finished level of floor correct to 5 mm.

- 6.9.7 Rate - Rate shall include the cost of all materials and labour involved in all the operations described above.

#### 6.10 Specifications for Kota Stone Flooring

Generally all works shall be in accordance with section 11.21 of CPWD Specifications 2019.

- 6.10.1 Kota stone slabs - The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

- 6.10.2 Dressing - Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of  $\pm 2$  mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of  $\pm 5$  mm for hand cut slabs and  $\pm 2$  mm for machine cut slabs shall be allowed.

- 6.10.3 Preparation of Surface and Laying - Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as given in the description of the item.

The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12 mm.

The slabs shall be laid in the following manner: Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sqm. The edges of the slab already paved shall be buttered with grey cement with admixture of pigment to match the shade of the slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on

the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge. Joint thickness shall not be more than 1 mm.

Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins / streaks or as directed by the engineer.

The slabs shall be matched as shown in drawings or as instructed by the Engineer.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.

#### 6.10.4 **Curing, polishing and finishing**

The day after the tiles are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shape of the topping of the wearing layer of the tiles.

The floor shall then be kept wet for a minimum period of 7 days. The grinding shall then be carried out with machine fitted with fine grade grit block (No. 120).

The final grinding with machine fitted with the finest grade grit blocks (No.320) shall be carried out the day after the grinding described in the preceding para or before handing over the floor, as ordered by the Engineer overall minimum three coats of polishing is to be done or as directed by the Engineer in charge to give complete mirror finish.

For small areas or where circumstances so require, hand polishing may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used

First grinding – medium grade (No. 80)

Second grinding – fine grade (No. 120).

In all other respects, the process shall be similar as for machine polishing.

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square meter sprinkled with water and rubbed hard with a 'namdah' block (pad or wooden rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished.

The finished floor shall not sound hollow when topped with a wooden mallet.

#### 6.10.5 **Measurements**

Kota flooring with different kind of stone shall be measured separately and in square meter correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 square meters. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square meter. Nothing extra shall be paid for laying the floor at different levels in the same room. Steps and treads of stairs paved with kotah stone slabs shall also be measured under the item of kotah Stone flooring.

#### 6.10.6 **Rate**

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

**6.11 Kota stone in Risers, of steps, skirting and Dado**

Generally all works shall be in accordance with section 11.21 of CPWD Specifications 2019.

Kota slabs and dressing shall be as specified above except that thickness of the slabs shall be 25mm or as specified in the description of the items. The slabs may be of informed size if required.

Preparation of surface shall be as specified as specified in 11.20.2 of the CPWD 2019 Specification.

Laying shall be as specified in 11.20.3 of the CPWD 2019 specifications except the joints of the slabs shall be set in grey cement mixed with pigments to match the shade of the slabs.

Curing, polishing and finishing shall be as specified in 11.20.4 of the CPWD 2019 Specification except that the first polishing with coarse grade corborandum stone shall not be done.

**6.11.1 Measurements**

Length shall be measured along with the finished face of riser, skirting or dado correct to a cm. Height shall be measured from finished level of tread of floor to the top (the underside of the tread in case of steps). This shall be measured to a mm in case of risers of steps and skirting and correct to a cm, in case of dado. The area shall be calculated in Sqm. Correct to two places of decimals.

Laying of pillars etc., shall also be measured under this item.

**6.11.2 Rate:** The rate shall include the cost of all the materials and labours involved in all the operations described as above.**7 FINISHING****7.1 Polyurethane Paint**

Polyurethane paint shall be MRF or equal approved make and shall be applied as per manufacturer's printed specifications.

**Material**

Aliphatic grade "Metal coat" applicable for metal surfaces shall be used which is comprised of Isocyanate hardener to be used in conjunction with Acrylic Polyol. The colour shall be as approved by the Engineer.

**Application**

Surface shall be properly cleaned and applied with suitable primer as per manufacturer's specifications. If surface is not smooth, it shall be treated with metal putty and primer.

Two coat of metal coat of thickness 25 to 30 microns shall be applied by spray and finished smooth.



S. no.	Parameter	Glossy	Matt	Remarks
1.	Product composition	PU	PU	
2.	Pack	Two	Two	
3.	Shade	As approved		
4a.	Viscosity by FC B4 at 30 Deg.C (Seconds) Part – A ii) Mix ii) M	45-50 30--35	45-50 30-35	
4b.	Application Viscosity	22-25	22-25	
5.	Specific gravity	0.98-1.2	1.16-1.3	
6.	Solid content	42-55	55-56	
7.	Thinner recommended	930/000	930/000	Thinner finish.
8.	Thinner intake	10-15%	10-15%	
9.	Mode of application	Spray	Spray	
10.	Curing schedule Surface dry Hard dry	30 Minutes O/N	30 Minutes O/N	
11.	Mixing Ratio	4:1	6:1	
12.	Finish	Smooth	Smooth	
13.	Recommended DFT (u)	25-30	25-30	
14.	Gloss (%)	90-95*	15-20*	At 60

### Specifications for Cement Plastering

Generally, all works shall be in accordance with Chapter 13 of CPWD 2019 Specifications. The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

- 7.1.1 Scaffolding and preparation of surface shall be as specified in 13.1.1 and 13.1.2 of CPWD 2019 Specifications.
- 7.1.2 **Mortar** - The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.
- 7.1.3 **Application of plaster:**
- 7.1.3.1 Ceiling plaster shall be completed before commencement of wall plaster.
- 7.1.3.2 Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 x 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness and then brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive trowel ling or over working the float shall be avoided.
- 7.1.3.3 All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.
- 7.1.3.4 When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned

and wetted with putty before plaster is applied to the adjacent areas, to enable the two to properly joint together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arises. Horizontal joints in plasterwork shall not also occur on parapet tops and copings at these invariably lead to leakages.

No portion of the surface shall be left out initially to be patched up later on.

**7.1.4 Finish** - The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds. The plastering and finishing shall be completed within half an hour of adding water to dry mortar.

**7.1.5 Thickness** - Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brickwork, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stonework the minimum thickness over the bushings shall be not less than 12 mm.

**7.1.6 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 expense by such means as the Engineer may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

**7.1.7 Precaution** - Any cracks which appear in the surface and all portions which sound hollow when lapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer.

i. When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green.

ii. To prevent surface cracks appearing between junctions of column/ beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. **For providing and fixing chicken wire mesh with U nails nothing extra shall be paid.**

**Rate quoted by the contractor is deemed to have included the same.**

**7.1.8 Rates** – The rate shall include the cost of all labour and materials involved in all the operations described as above.

## **7.2 Specifications for White Washing with Lime**

Generally, all works shall be in accordance with section 13.14 of CPWD Specifications 2019.

### **7.2.1 Scaffolding**

**7.2.1.1** Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest or touch the surface which is being white washed.

**7.2.1.2** For all exposed brickwork or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

### **Note**

In case of special type of brickwork, scaffolding shall be got approved from Engineer in advance.

7.2.1.3 Where ladders are used, pieces of all gunny bags shall be tied on their tops to avoid damage or scratches to walls.

7.2.1.4 For white washing the ceiling, proper stage scaffolding shall be erected.

7.2.2 **Preparation of surface** - Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings and foreign matter.

7.2.3 **Preparation of lime wash**

7.2.3.1 The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun Quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic decimetre of the cream. The approximate quantity of water to be added in making the cream will be 5 litres of water to one kg of lime.

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

7.2.4 **Application**

The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

7.2.5 **Protective Measures**

Doors, Windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

7.2.6 **Measurements**

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

Measurements for jambs, Soffits, and Fills etc. for openings shall be as described.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area.

Corrugated asbestos cement sheet	-	20%
Semi corrugated asbestos cement sheet	-	10%

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

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

### 7.3 **Specifications for Wall Painting with Plastic Emulsion Paint**

Generally all works shall be in accordance with section 13.31/13.46 of CPWD Specifications 2019. The plastic emulsion paint is not suitable for application on external, wood and iron surface and surfaces, which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel.

7.3.1 **Materials:** Plastic emulsion paint as per IS: 5411 of approved brand and manufacture and of the required shade shall be used.

#### 7.3.2 **Painting on new surface**

7.3.2.1 **Preparation of Surface** - The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the engineer after inspection, before painting is commenced.

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

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.

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

#### 7.3.2.3 **Precautions**

- i. Old brushes, if they are to be used with emulsion paints should be completely dried of turpentine or oil paints by washing in warm soap water. Brushes should be quickly washed in water

- immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.
- ii. In the preparation of wall for plastic emulsion painting, no oil based putties shall be used in filling cracks, holes etc.
  - iii. Splashes on floors etc. shall be cleaned out without delay, as they will be difficult to remove after hardening.
  - iv. Washing of surfaces treated with emulsion paints shall not be done within 3 or 4 weeks of application.
  - v. Other details shall be as specified as far as they are applicable. The primer is to be used as specified by the manufacturer and approved by the Engineer.

## **SUSPENDED CEILING**

7.4

### **General**

Suspended ceiling shall be of metal suspension system, Aluminium lineal ceiling, G.I. metal tile ceiling, Aluminium metal tile ceiling or Armstrong tile ceiling or equivalent in flat, tapered, curved or circular form both in plan and in section together with cover etc., as per design approved by the Engineer in charge

7.5

### **Specialized Workmen**

All work shall be done by the Contractor directly or by an experienced specialist sub-contractor who shall be appointed only after prior approval of the Engineer.

7.6

### **Checking and Approval before Starting**

Work of ceiling shall only be started after all major work such as masonry work, plaster, window and door fixing and flooring are complete. Before starting dropped ceiling work, all related work such as ducting, electrical and other work, any painting above the dropped ceiling etc., if required shall be completed and thoroughly checked and approved.

7.7

### **Coordination & Approval of Shop Drawings**

The dropped ceiling work in general shall be fully coordinated with light fittings & all other electric fixtures, A.C. ducts and grilles, fire/smoke detectors, access panels, pelmets, columns and partitions. Detailed shop drawings on this basis suited to the exact site conditions and dimensions for each separate area shall be prepared by the Contractor and got approved by the Engineer well before proceeding with the work. Samples shall be prepared at the site for each type of false ceiling and got approved before commencing the work.

7.8

### **Lines & Levels**

All framing work shall be done with approved wood or with proprietary metal suspension system as required and shown. The wood battens shall be securely fixed to walls and columns by approved heavy duty metal fasteners and to the slab above with M.S. straps or bars of required sections, anchored therein. All wood framing, for ceiling shall be given two coats of wood preservative fire resistant coating. The underside of the framing shall be true to planes and slopes. Bottom of the frames shall be planed true to levels. For bulkheads, the frames with cross runners fixed horizontally shall be truly in plumb and plane.

Care shall be taken to see that ceiling, unless otherwise required, are absolutely horizontal, flat and in one level, no waviness being allowed. Grooves, lines and patterns, if any, shall be maintained in straight or curved lines as required accurately as per drawing.

7.9

### **Metal Suspension System**

Where specified, the ceilings shall be installed with approved proprietary snap grid exposed grid suspension system recommended by the dropped ceiling tile manufacturer's comprising Tee's with main runners, cross-runners, wall channels, suspension hangers, holding channels and holding down clips. The material of the suspension system shall be of tested special spring grade steel accurately formed and die cut with identical ends. All members shall be vinyl coated fully treated and protected against corrosion. The layout of the grid shall follow the ceiling pattern of the tiles as shown and required.

**7.10 Handling and Storage**

All the components shall be stored under cover in clean and dry conditions in a dust free area and shall not be allowed to come into contact with cement, lime, plaster, mortar etc. which can damage them. Special care shall be taken in stacking Plaster of Paris bags. They shall be kept in dry conditions on a raised platform with wooden planks. The stacks shall be kept away from the walls.

**7.11 Cutting**

Power tools shall be employed for the work. Manual work shall be done only under exceptional circumstances with the prior permission of the Engineer.

**7.12 Cavity Barriers and Partitions**

Cavity barriers shall be provided, to prevent spread of fire, above suspended ceilings in accordance with the details recommended by the manufacturer and as directed by the Engineer.

Partitions for isolation of different air conditioning zones/rooms shall be of specifications similar to that of the suspended ceilings.

The cavity barriers and the partitions shall be measured in sqm. as for the suspended ceiling and shall be paid at the same rate as that of the suspended ceiling.

**7.13 Aluminium Lineal False Ceiling Material****7.13.1 Material**

Aluminium ceiling wherever shown shall be Track or Hunter Douglas or equal approved powder coated Aluminium strip dropped ceiling with perforated / plain panels of approved shade. The ceiling shall be supplied and fixed by specialized workmen approved by the manufacturer, strictly as per manufacturers printed instruction. The panel will be 84mm x 16 mm deep with recessed flanges of made out of 0.50mm Aluminium alloy AA3105 with powder coated finish.

**7.13.2 Installation**

The ceiling including suspension system shall be installed as per the material specifications and printed instructions of the manufacturer. Provision for cut outs for lights and air-condition diffusers etc. shall be made as shown in the drawings and as required at site. The entire installation shall meet the approval of the Engineer.

**7.13.3 Suspension**

The ceiling panels shall be fixed at maximum 1500 mm c/c carriers to be suspended from slab/roof by 4 mm dia galvanized wire hangers with special height adjustment clips made out of spring steel including all trims, angles, recessed edges profile (20 mm x 20 mm) screwed to panel carrier 84 R Exterior grade@ 1300 c/c.

**7.14 Aluminium metal tile false ceiling**

The ceiling shall be of approved brand as directed by Engineer. The ceiling shall be supplied and fixed by specialized workmen, strictly as per approved manufacturers printed instruction.

**Material**

600 x600 perforated panels manufactured out of 0.7mm thick Aluminium. The tile will be manufactured on advanced equipment. Tile ends will be raised with pips and stops to ensure positive engagements into the spring to enable for demounting of individual panels. The tile sides will be sufficiently high to ensure a minimum deflection across the length of the tile. All tiles will be beveled edged. The tile shall be polyester based, powder coated in white color. The tile shall be clipped into clip in profile of 0.5mm thick G.I. The clip in profile shall be supported from slab by means of rigid suspension of 4mm G.I. rod, hold on clamp with clip as per manufacturer's instructions.

**7.15 G.I. powder coated tile false ceiling**

The ceiling shall be of Hunter Douglas make or approved equivalent.

600 x600 perforated panels manufactured out of 0.5m thick GI powder coated. The tile will be manufactured an advanced equipment. Tile ends will be raised with pips and stops to ensure positive engagements into the spring to enable for demounting of individual panels. The tile sides will be sufficiently high to ensure a minimum deflection across the length of the tile. All tiles will be beveled edged. The tile shall be polyester based, powder coated in white color. The tile shall be clipped into clip in profile of 0.5mm thick G.I. The clip in profile shall be supported from slab by means of rigid suspension of 4mm G.I. rod, hold on clamp with clip as per manufacturer's instructions.

#### **Polycarbonate sheets**

7.15.1

##### **Material**

The material is made of 2mm thick polycarbonate sheets of GE plastics make or Tuflite or approved equivalent. The material shall conform IS: 14443: 1997 and ASTM D 792. The polycarbonate sheet should have ultra violet resistance capacity on both the sides and it should be of excellent glazing material. The length of the polycarbonate sheet will be as per the manufacturer's specifications.

7.15.2

##### **Installation**

The polycarbonate sheets shall be fixed as per drawings to match the same profile of roof sheeting and fixing all as per following manufacturer's specifications and approved by the Engineer in charge.

7.15.3

##### **Measurements**

Length and breadth to the nearest cm and over shall be calculated in Sqm correct to two decimal places.

7.15.4

##### **Rates**

Rates shall include cost of material, labour, fixing involved in the operation.

## **8**

### **METAL WORK**

8.1

#### **Scope of Work**

The work shall include providing metal work in the building for door frames, balustrades, handrails, railings, grill work, frame work of sky lights, inserts, fasteners, lugs using plates, chequered and plain plates, flats, strips, squares, rounds, tubes, pipes, angles, channels, tees, expanded metal, I-sections, etc., including cutting, filing, grinding, drilling, mechanical fastening, welding, etc., at locations and situations as directed by the Engineer in accordance with the design, patterns, shapes, thicknesses, details all as shown on the drawings or as specified or as directed by the Engineer and also as per the Specifications, standards and codes as given herein under, complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer.

8.2

#### **Applicable Specifications**

8.2.1

All work shall be done as per CPWD specifications 2019 except as modified herein under and as per the additional requirements given herein under.

8.3

#### **Shop Drawings**

8.3.1

All work shall be executed as per approved shop drawings. The shop drawings shall inter alia show the complete details of the connections including the fixing arrangement to concrete or brick work or flooring, etc., the size of the welds/bolts/nuts/washers/ grinding finish/tolerances, etc.

8.4

#### **Samples**

8.4.1

The Contractor shall submit samples of all materials that are called for by the Engineer. The Contractor shall prepare samples of workmanship and mock-up for approval.

8.5

#### **Protection**

8.5.1

The Contractor shall protect the work at all times from any damage. All finished work shall be protected by polythene-wrap or other approved means.

8.6

#### **Inserts**

8.6.1

The Contractor shall fix all necessary inserts such as steel plates, pipe sleeves, bolts etc. and make provision of holes, pockets, dowels, etc., in the form work to enable subsequent fixing of supports, brackets, ceilings, precast members, etc., as indicated on the drawings or called for in the Schedule of

Quantities or as required by the Engineer. Concrete inserts shall be as per IS: 1946 and of a type approved by the Engineer.

- 8.6.2 Rate quoted for inserts is deemed to be inclusive of placing them in position and nothing extra is payable for the same. Nothing extra over and above the provision as per the priced schedule of quantities shall be paid to the Contractor for placement of inserts in position before concreting.

## 8.7 Fire Check Door

### 8.7.1 General

The shutter of the door of approved make conforming to IS: 3614 (Part II) 1966 shall be so designed so as to provide the specified fire resistance when tested as per IS: 3614 (Part 2): 1992 and BS: 476- Part 22 to suit the specified requirement and the manufacturer must produce certificates of a recognized laboratory to the satisfaction of the Engineer.

### 8.7.2 Frame

Door frames of 16 SWG G.I. tube of size 143 x 57mm approximately or as specified by the manufacturer with a tolerance of  $\pm 3$ mm section (nominal) with heat activated intumescent fire seal strips of size 12mm x 4mm (for smoke sealing) mounted in the groove in frame or EPDM gasket to act as smoke seal suitable for mounting 120 minutes fire rated shutters with one coat of anti-termite fire retardant primer.

### 8.7.3 Sill

The sill shall be of 16 SWG G.I. tube.

### 8.7.4 Panels

The shutter of overall thickness 60mm formed out of 2 outer skin panels of 1.25 mm galvanized steel sheets having lock seam joints for locking. Reinforcements shall also be provided at locking / hardware area. The sheet metal used for both the frames and the shutters conform to IS 277: 1992. The shutter shall be free from twist or warp in its plane. Tolerance on width and height shall be  $\pm 3.0$ mm and tolerance on nominal thickness shall be  $\pm 1.2$  mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8mm when measured at any two points. In fill materials shall be proprietary ceramic based infill material with internal reinforcements, infill materials as approved by CBRI.

Two nos. stainless steel ball bearing butt hinges shall be used for each leaf of height not more than 1.2m and three hinges shall be used for each leaf of height more than 1.2m. Butt hinges minimum of 100mm and 75mm shall be used for shutters having height more than 1.2m and height less than 1.2m respectively. For shutter of more than 40mm thickness, butt hinges of size 125 x 90 x 4mm shall be used.

### 8.7.5 Hardware's/Fittings

All fittings used in the manufacturer of the door shall be heavy-duty type. The doors shall be fitted with heavy-duty concealed type automatic door closers, of approved make. All fittings should also withstand the fire temperature and should not melt during 120 minutes of fire rating.

### 8.7.6 Panic Bar/Exit Devices

These shall be of press type panic bars with 4 point latch system either single or triple latch. The panic bar shall be fire rated for 120 minutes of the fire duration.

### 8.7.7 Seal

A heat activated intumescent seal of approved quality and make conforming to BS: 476 (Part-8) or EPDM gaskets shall be provided on all edges of door to check the spread of smoke in case of fire.

### 8.7.8 Paint

The doorframe and panel shall be primed in stoving grade epoxy zincphosphate primer and finished in aliphatic grade UV resistant polyurethane paint.



- 8.7.9 Vision panels wherever required to be fixed with clip on window frames with no screws and fasteners on the surface, fire rated vision glass to be 6mm thick borosilicate float glass/ pyran glass fixed on vision panels with 5mm ceramic fiber tape
- 8.8 **Particle Board Door with Aluminium Stiles and Frame**  
The work shall include providing and fixing of door made with prelaminated particleboard and Aluminium as per drawing. The sample of the door including colour of powder coating is to be got approved by the Engineer before mass fabrication.
- 8.8.1 **Material**  
Prelaminated particleboard shall be as specified in clause 3.6, Section 12.  
Aluminium frames, stiles, channels etc. will all conform as described in clause 8.11. of this section.
- 8.8.2 **Installation**  
Prelaminated particleboard shall have U-type Aluminium edging on three sides and overlapping rebate type U-edge on vertical edge (on locking side) of the panel. Aluminium frame shall be fixed to wall with non-rusting, coloured screws and raw plugs. Heavy duty hinges will be used which will be inserted through slits made in the frame and U-type edging.  
  
The door shall be in true alignment for smooth movement.  
  
Provisions for all ironmongery, vision panel air transfer grilles etc. is to be made as required.
- 8.9 **Metal Doors**
- 8.9.1 **General**  
The work shall include providing and fixing metal door including frame of approve make and quality as per specified requirement to the satisfaction of the Engineer. Provisions shall be made in panel / frame for ironmongery, vision panel, air transfer grilles etc. Sample of the door is to be approved by the Engineer.
- 8.9.2 **Material**  
Door panel shall be fabricated from 0.90 mm thick G.I. sheets with infill of honeycomb craft core.  
  
Doorframe shall be fabricated from 1.60 mm thick galvanized steel sheet and of required dimensions.  
  
Stainless steel hinges of adequate strength to be provided for single / double leaf doors.  
  
Double leaf doors will have rebated meeting stile.
- Installation**  
Door panel shall be minimum 46 mm thick made with press formed G.I. sheet panel will be fully flushed double skin with lock seam joints at stile.  
  
Doorframe of required dimension shall be fixed to the wall with M.S. lugs / holdfast. Doorframes shall be filled up with P.C.C., 1:5:10 (1 cement: 5 aggregate: 10 coarse sand).
- Painting**  
Door shutter and frame shall be primed in stoving grade epoxy zinc phosphate primer and finished in aliphatic grade U.V. resistance polyurethane paint.
- 8.10 **Stainless Steel Handrail**
- 8.10.1 **Scope of Work**  
The work shall include providing and fixing of handrail, stainless steel grating, stainless steel plate for expansion joints and other things necessary to complete the work as specified and shown in the

drawings complete in all respect to give the quality of finished work as desired by and to the entire satisfaction of the Engineer.

#### 8.10.2 **Approvals**

The sample of the material shall be submitted to the Engineer for approval before fabrication of the work.

#### 8.10.3 **Material**

Handrail shall be made of welded cold drawn solution annealed and pickled; stainless steel tubes grade 304 as per ASTM-A 249-95a.

Outer diameter of the tube will be as specified and shown in the drawing. Thickness of wall will be 10 gauge as specified. Finish of the tubes will be matt / buff as specified.

Material shall confirm to mechanical test of tensile strength, yield strength, elongation, hardness, flanges, flattening, heat analysis, reverse bending etc.

Chemical composition in % will be as follows:

<b>C</b>	<b>Si</b>	<b>Mn</b>	<b>P</b>	<b>S</b>	<b>Ni</b>	<b>Cr.</b>	<b>Mo</b>
0.035 Max.	0.75 Max.	2.00 Max.	0.040 Max.	0.030 Max.	10.00 15.00	16.00 18.00	2.00 3.00

#### 8.10.4 **Installation**

G.I. sleeve of 40mm dia will be grouted in the steps / landing of staircases or railing as specified and shown in the drawing. 25mm dia stainless steel baluster will be bolted to the sleeve and lead jointed. The baluster will be welded to 50mm dia stainless steel handrail. Stainless steel round cover will be fixed to the bottom of baluster. Ends of the handrail tube to be capped wherever required. While assembly is to be true in line and upright as per requirement.

Work shall include providing and fixing stainless steel works as specified and required as per relevant drawing. The whole work shall be finished absolutely clean, true in line and lengths and in workman like manner. Approval for specific items shall be obtained in advance from the Engineer.

Installation will be done to suit the site conditions and as shown in the drawings. All necessary screws, nuts, bolts, welding, threading, chasing, cutting, supporting and making them good shall be done as required.

#### 8.11 **Aluminium work and Glazing**

##### 8.11.1 **Scope of Work**

The work shall include providing aluminium and glazing for the building for doors, windows, glazing, skylights, semi-unitized structural curtain wall system, etc., and at any other locations and situations as directed by the Engineer-in-Charge in accordance with the design, patterns, shapes, thicknesses, details, all as shown on the drawings or as specified or as directed by the Engineer and also as per the specifications, standards and codes as given herein under, complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer-in-Charge.

The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the Engineer.

##### 8.11.2 **Materials**

##### 8.11.2.1 **Aluminium**

**Aluminium Sections:** Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-in- Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304.

The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-in-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-in- Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in-Charge and nothing extra shall be paid on this account.

### **Powder Coating**

**Material:** The powder used for powder coating shall be Epoxy/polyester powder of make approved by the Engineer- in-Charge. The contractor shall give detailed programme for powder coating in advance, to facilitate the inspection by Engineer-in-Charge or his authorized representative.

### **Pre-treatment**

Each aluminium alloy extrusion or performed section shall be thoroughly cleaned by alkaline or acidic solutions under the conditions specified by chemical conversion coating supplier and then rinsed. A chemical conversion coating shall be applied by treatment with a solution containing essentially chromate ions or chromate and phosphate ions as the active components as applicable. The amount of the conversion coating deposited depends on the type used by the conversion coating chemical supplier. The conversion coating shall be thoroughly rinsed either with the solution specified by the conversion coating chemical supplier or with de-mineralized water and then dried at the temperature for the time specified by the conversion coating chemical supplier. The contractor shall submit the detail specifications and application procedure for application of conversion coating for approval of Engineer-in-Charge. The metal surface after the conversion coating pre-treatment and prior to the application of the coating shall be free from dust or powdery deposits.

**Process:** The polyester powder shall be applied by electrostatic powder spray method. Before start of powder coating the contractor shall submit detail specification for application of polyester powder from manufacturer of the polyester powder for approval of Engineer-in-Charge. The powder coating shall be applied as per the specification approved by Engineer-in-Charge.

**Thickness:** The thickness of the finished polyester powder coating measured by micron meter shall not be less than 50 micron nor more than 120 micron at any point.

### **Performance Requirements for the Finish**

- (i) **Surface appearance:** The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.
- (ii) **Adhesion:** When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the Engineer-in-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

**Protection of Powder Coated / Anodizing Finish :** It is mandatory that all aluminium members shall be wrapped with self-adhesive non-staining PVC tape, approved by Engineer-in-Charge.

#### 8.11.2.2 Glass

Glass shall generally conform to the requirements of BS: 952 or JIS: R3203 or equivalent standards. It shall be clean cut without edge faults and free from defects. Glasses shall be tested for critical parameters like flexural bending strength, fragmentation, bow and corrugation as per DIN: 1249 Part-12 with necessary test certificates from the manufacturer for each lot.

##### a) Float Glass

Glass shall be clear Float Glass or Body Tinted Float Glass, conforming to JIS: R3203 manufactured by Saint Gobain glass, Belgium glass, Float Glass India Ltd. or Gujarat Guardian Ltd. or approved equivalent manufacturer.

##### b) Toughened Glass

Clear or Tinted Float Glass shall be toughened (tempered) for applications where specified. The glass shall be horizontally tempered as per DIN: 1249 Part-12 having no tong or suspension mark and shall have machined edges with no burrs or sharp surfaces.

##### c) Laminated Glass

Two panes of Clear or Tinted Float Glass shall be laminated using a layer of PVB 1.52 mm. Laminated glass shall be provided where specified. The preparation of Laminated Glass shall be as per BS: 952 Part-1.

##### d) Mirrors

Mirrors shall be Copper Silvered Float Glass backed with two coats of paint applied by curtain coat technology.

##### e) Insulating Glass

The Insulating Glass shall conform to BS: 5713 and shall comprise two panes of Float Glass fixed with a gap of 12mm created by a spacer and hermetically sealed around the edges leaving a dehydrated air space.

#### 8.11.3 Weather Stripping

Weather stripping shall be wool pile manufactured by an approved Company. The profile shall be as follows:

Application	Base Width	Pile Height
Sliding windows and doors	6.7mm	7.0mm
Casement windows	6.0mm	5.0mm
Swing doors	9.0mm	8.0mm

Gaskets shall be of Ethylene Propylene Diene Monomer (EPDM) of approved profile and manufacturer.

#### 8.11.4 Handling and Storing Materials

Aluminium Work Fabrication and Components

All self-finished work shall be wrapped, taped or protected in an approved manner with non-absorbent coverings.

These shall be delivered to a programme to reduce or eliminate site storage.

Coverings shall be removed just sufficient to enable jointing and assembling and shall be replaced thereafter.

#### 8.11.5 **Glass**

Glass shall be stored in dry, shaded and ventilated areas, on firm straight supports. Water collection (condensation) between panes shall be prevented.

Mirrors shall be delivered wrapped and shall be kept wrapped until the time of fixing.

Different types of mirrors/glasses shall be stacked separately with proper identification.

### 8.12 **Workmanship**

#### 8.12.1 **General**

Aluminium work shall be undertaken in accordance with sound engineering practice and as follows:

- a) sAluminium work shall be done as much as possible in the properly equipped workshop.
- b) Site work shall be restricted to fixing and other operations that cannot be undertaken in the workshop.
- c) Burrs, sharp edges and angles, coarse file marks, excess weld metal and similar imperfections shall be removed.
- d) Work shall not be permitted to corrode or otherwise deteriorate between fabrication and final treatment/fixing.
- e) Aluminium work shall be fixed in the works in a manner that prevents corrosion due to contact with incompatible metals and other materials.

#### 8.12.2 **Bending and Joint Faces**

Aluminium shall be shaped by bending with machine without weakening or otherwise damaging the same.

Joint faces shall be formed to fit accurately in full contact. A suitable joint coating shall be used for bolted or screwed connections.

#### 8.12.3 **Cutting Glass**

All edge and surface treatment shall be done at the glass works after cutting to size. Glass shall be cut to produce clean square edges. Any work to Toughened Glass shall be undertaken by the glass manufacturer prior to the toughening process. The edge of multiple glazed units shall not be nipped.

### 8.13 **Design**

The glazing for the building, including windows, skylights and doors, shall be designed by the manufacturer as per BS: 6262 British Standard Code of Practice for Glazing for buildings, to withstand wind loadings as given by IS: 875 and provide seismic isolation and restraint for buildings located in Seismic Zone-II as per IS code.

The Contractor shall submit complete design calculations for the design of the glazing for the approval of the Engineer.

The Contractor shall order materials only after the designs are approved by the Engineer.

### 8.14 **Performance**

The performance of windows, glazing, doors, skylights shall be as given in BS: 6375 Parts 1 and 2 for weather tightness, operation and strength.

### 8.15 **Tests**

Tests for performance shall be carried out by the Contractor as per following:

BS: 5368 Part 1 – Air Permeability Test  
 BS: 5368 Part 2 – Water Tightness Test under Static Pressure  
 BS: 5368 Part 3 – Wind Resistance Test

The Engineer shall decide as to which windows shall be subjected to test.

**8.16 Test Report**

The test reports shall be submitted in quadruplicate as per the format given in BS: 5368 Part-4.

**8.17 Sub Frames**

All aluminium work shall be fixed to mill finished aluminium tubular sub frames. The sub frames shall be fixed to brick work/concrete work using expansion bolts as directed by the Engineer

**8.18 Mock-up and Samples**

Before preparation of shop drawings the Contractor shall submit samples of all preformed and extruded sections proposed to be used. The Contractor shall also submit samples of colours of coating based on the colours requested by the Engineer. Once preliminary approval is given and shop drawings are approved by the Engineer, the Contractor shall submit final samples of typical windows, complete in all respects.

**8.19 Sealants**

The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminium section and RCC/Stone masonry) shall be of make approved by the Engineer in Charge.

**8.20 Isolation**

Where aluminium comes into contact with masonry, brickwork, plaster or dissimilar metals, it shall be coated with an insulating coat of lacquer, paint or tape to ensure the electro- chemical corrosion is avoided. The Contractor shall submit his proposal for the approval by the Engineer-in-Charge before related materials are ordered.

**8.21 Protection**

The Contractor shall protect the powder coated aluminium sections with clear or coloured tape. The tape shall not disfigure the finish.

The Contractor shall protect installed work with suitable measures to the entire satisfaction of the Engineer.

**8.22 Protection Against Damage**

Care shall be taken to avoid damage from any cause at all stages. Packing pieces used for protection shall not disfigure or otherwise permanently mark the works.

Surface protection shall be afforded by careful handling and the avoidance of the use of hooks, crowbars or other implements that are likely to damage the stone, marble, granite, limestone, timber, doors, windows, metals, glass, etc. Oils, grease, paint; cement slurry and liquid agents liable to cause staining shall not be used in close proximity to the area in which the materials are stacked.

Protection during Construction – Decorative surfaces shall be carefully protected during construction by a temporary cover of adequate strength and durability.

Protection of finished work – At all stages of the contract it is essential that all works are properly and effectively protected.

Particular attention shall be given to permanently exposed surfaces, especially arises and decorative features. The protection may be by timber strips, hessian or polyethylene, but shall not be such as will damage, mark, or otherwise disfigure the work.

Polyethylene heavy-duty sheeting may be used as protection against rain. It may be necessary in certain cases to avoid contact of water with the materials.

Timber battens protecting sills or other rises shall be retained in position as long as possible.

Suitable packing shall be used to ensure that scaffolding does not damage erected stone, marble, granite or other finished works.

Work on the upper stages of the super structure shall not be allowed to damage or disfigure the work in the lower levels.

Unless special precautions are taken for winter working, the use of mortar shall be avoided when the thermometer reads 2 degree and falling and the joints shall be protected.

Any disfigurement, discolouration or imperfection whatsoever due to any reason shall not be accepted and the Contractor shall either remedy the same or redo the work at no extra cost. The decision of the Engineer as to whether any work either in whole or in part is acceptable or not shall be final and binding on the Contractor.

#### 8.23 **Glazing**

Adhesive labels for indicating "Glazing completed" shall be easily removable without scraping. Marking with lime shall not be used for this purpose.

Glass shall be protected against mechanical damage.

Any alkaline splashes shall be removed before they harden.

#### 8.24 **Tolerances**

The size of aluminium work shall not vary by more than  $\pm 1.5\text{mm}$ .

#### 8.25 **Cleaning and Completion**

On completion of the first area of aluminium work and glazing and the quality of work accepted, the same shall be cleaned of all dust and other deposits.

This area of aluminium work and glazing shall be retained as a sample of the finished work, wherein the effects of weather, movement and other conditions shall be reviewed over a period not exceeding one month and the effects if found leading to unsatisfactory work, shall be remedied by the Contractor, until a satisfactory sample of finished work is accepted. All other work shall thereafter be completed to the same standard and quality as approved.

#### 8.26 **Acceptance Criteria**

##### **Acceptance of Work at Intermediate Stage**

The work executed on any day shall be checked at the end of that day or the next day before commencement of further work. Any work found to be of acceptance quality or not in accordance with the specification should be rejected, removed and replaced before proceeding with further work.

##### 8.26.1 **Final Acceptance of Work**

Various stages of approval are required to be met by the Contractor. Regardless of the acceptance of work at intermediate stages, the final acceptance shall only be accorded once the entire work is complete in one area of the building; after all other works as per this Contract have also been duly completed and accepted.

**8.27 Ironmongery**

For fixing ironmongery and friction hinges, if the wall thickness of the extruded aluminium section is not adequate to take the threading of the screws, the Contractor shall provide additional thickness with built-up sections, etc., as required.

All ironmongery including sliding gear for sliding glazing's / windows and the friction hinges for side hung projected windows shall be supplied and installed by the Contractor. The Contractor shall supply Catalogues and samples for approval of the Engineer.

**8.28 Specifications for Steel Rolling Shutters**

Generally, all works shall be in accordance with section 10.8 of CPWD Specifications 2019.

Rolling shutters shall conform to IS 6248. These shall include necessary locking arrangements and handles etc. These shall be suitable for fixing in the position as specified i.e. outside or inside on or below lintel or between jambs of the opening. The door shall be either push or pull type or operated with mechanical device supplied by the firm. Shutters up to 10 sq. metre shall be of push and pull type and shutters with an area of over 10 sq. meter shall generally be provided with reduction gear operated by mechanical device with chain or handle, if bearings are specified for each of operation, these shall be included in the rates.

**8.28.1 Shutter**

8.28.1.1 The shutter shall be built up of interlocking lath section formed from cold rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 1.25 mm. Shutters above 9 meters in width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the backside to resist wind pressure. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centres. Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking the lath section at both ends and preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

**8.28.2 Spring**

The spring shall be of coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454 – Part I.

**8.28.3 Roller and brackets**

The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS 1161. For shutter up to 6 metre width and height not exceeding 5 metre, steel pipes of 50 mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters up to a clear height of 3.5 metre. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5 m up to 6.5 m. The suspension shaft clamped to the brackets shall be fitted with routable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall be connected by means of pretensioned helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 metre, the cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self-aligning two-row ball bearing with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15 mm and at least 4 number flats running throughout length of roller shall be provided.



In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a pinion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

#### 8.28.4 **Guide channel**

The width of guide channel shall be 25 mm the minimum depth of guide channels shall be as follows

Clear width of shutters	Depth of guide channel
Up to 3.5 m	65 mm
3.5 m up to 8 m	75 mm
8 m and above	100 mm

The gap between the two legs of the guide channels shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent rattling of the shutter due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the walls or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide channels shall be attached to the jambs, plumb and true either in the overlapping fashion or embedded in grooves, depending on the method of fixing.

#### 8.28.5 **Cover**

Top cover shall be of mild sheets not less than 1.25 mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS 6248.

#### 8.28.6 **Fixing**

The arrangement for fixing in different situations in the opening shall be as per IS 6248.

Brackets shall be fixed on the lintel or under the lintel as specified with raw, plugs, and screws bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the wall through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screws bolts, and raw plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workman like manner that the operation of the shutter is easy and smooth.

#### 8.28.7 **Measurements**

Clear width and clear height of the opening for rolling shutter shall be measured correct to a mm. The clear distance between the two jambs of the opening shall be clear width and the clear distance between the sill and soffit (bottom of lintel) of the opening shall be the clear height.

The area shall be calculated in square metres correct to two places of decimal.

#### 8.28.8 **Rate**

The rate shall include the cost of materials and labour involved in all the operations described above including cost of top cover and spring except ball bearing and mechanical device of chain and crank operation, which shall be paid for separately.

#### 8.29 **Specifications for Steel Rolling Grills - Shutters**

Generally, all works shall be in accordance section 10.9 of CPWD Specifications 2019.

**8.29.1 Rolling grill is to be provided as shown in the approved drawings and instructed by the Engineer in charge.**

8.29.2 Rolling grills are similar in design, construction and operation of rolling shutters and all the provisions shall be applicable to rolling grills except in respect of the shutter portion, and shall conform to IS 6248.

**8.29.3 Shutters**

Rolling grill shutter and the rolling grill portion of the rolling shutter – cum – grill shall be fabricated with 8 mm diameter mild steel round bars. Straight bars and bars bent to the required profile are placed alternatively and held in position with 20 mm wide and 5 mm thick mild steel flat links. Straight bars shall be spaced not exceeding 150 mm centre to centre and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars. Unless otherwise specified or directed by the engineer, bars placed alternatively with straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120 mm and the depth of corrugation is 80 to 100 mm. All the bent bars shall have uniform profile. Straight bar along with the adjoining bent bars on it both sides shall be held in position by passing the bars through holes in the links. Each link shall have three holes and the length of the links shall be such that the distance from the centre of the hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be the same as centre to centre distance between two consecutive crests/troughs of the bars bent to the required profile. Each bar and link shall be a continuous single piece without any joint.

**8.29.4 Measurement and rate**

The measurements and rate shall be as specified in 7.28. In case of Rolling Shutter – cum – Grill, where the area of the grill portion is half or less than half the area of opening, it shall be measured and paid as rolling shutter and where the area of grill portion is more than half the area of opening, it shall be measured and paid as rolling grill.

**9 WATER PROOFING**

**9.1 Waterproofing of Raft and Retaining Walls**

9.1.1 Waterproofing of Raft and Retaining walls by external tanking (including grouting of Concrete)

9.1.1.1 External tanking (including grouting of concrete) of basement, trenches, tunnel etc. shall be carried out using an approved acrylic chemical waterproofing compound, in stages given below:

**9.1.1.2 Stage 1:**

After the lean concrete has been laid to receive the RCC raft, a 345 mm thick brick toe wall in Cement Mortar 1:6 shall be constructed, on the perimeter of the area to be water proofed. The height of this wall shall be equal to the thickness of the RCC Raft. The brick toe wall shall be paid separately under the item of Brickwork.

**9.1.1.3 Stage 2: Base**

The external tanking treatment shall be carried out for the base raft over the lean concrete in the following sequence.

- a) A layer of cement slurry mixed with the acrylic-waterproofing compound shall be spread over the lean concrete.
- b) In each layer where acrylic-waterproofing compound is to be used it shall be mixed in the ratio of 400 gms per 50 kg. Of cement unless specified otherwise.
- c) Thereafter a 25mm thick (minimum) bedding layer of cement mortar 1:3 (one part cement: three parts coarse sand) mixed with acrylic waterproofing compound shall be laid.
- d) Curing shall be done by spraying water for 7 days.
- e) A layer of Kota/Cuddapa stone slabs of approximately 600 x 600mm and having minimum thickness of 30mm shall be laid. The joints between the stones shall be 6mm. After laying the joints shall be raked and sealed with cement mixed with acrylic waterproofing compound (in the ratio 1:1).
- f) A layer of cement mortar 1:4 (one part cement: four parts coarse sand) mixed with acrylic waterproofing compound shall be laid and finished smooth.
- g) Curing shall be done by spraying water for 7 days.
- h) The waterproofing shall be turned up along the brick wall on the perimeter of the basement raft. The work shall be carried out as described under walls.

NB: The above specification shall also be followed for the roof of basement.

#### 9.1.1.4 **Stage 3: Grouting of Concrete**

##### 9.1.1.4.1 **Raft**

Placing and prefixing of 15mm M.S. nozzles of length 0.5D where D is the depth of the raft shall be done on the construction joints and pour strips. The spacing of the nozzles shall be 1 m apart in both directions in the raft to enable grouting to be done. The pipes shall project 50mm above the top of the raft and shall be plugged using M.S. caps.

The RCC shall be cast after placement of the nozzles as required.

After the concrete of raft has attained proper maturity the injection of cement mixed with non-shrink polymeric grouting compound through the nozzles under maximum pressure of 2.5 kg/sqcm. By hand/air/electric/pump shall be carried out.

The nozzles shall be sealed after injection operation is over with a cementitious rendering with quick setting admixture of CICO make or approved equivalent.

The above specification shall also be followed for the roof of basement if required.

##### 9.1.1.4.2 **Retaining Wall**

On removal of the form work if the external surface is found to be honeycombed, irregular surface shall be rendered with cement: sand mortar (1:3) after removing oil and greasy substances, if any.

Placing and pre or post fixing of 25mm M.S. nozzles of length reaching half the wall thickness shall be done along construction joints and pour strips. The spacing of the nozzles shall be 1m to 1.5 m apart in both directions. In the case of prefixing this step shall be executed before concreting of retaining walls. Care shall be taken to terminate the concreting at the level of injection nipples.

After the concrete of retaining wall has attained proper maturity the injection of cement mixed with non-shrink polymeric grouting compound through the nozzles under maximum pressure of 2.5 kg/sqcm. By hand/electric pump shall be carried out.

The nozzles shall be sealed after injection operation is over with a cementitious rendering with quick setting admixture of CICO make or approved equivalent.

**9.1.1.4.3 Stage 4 : External tanking of Walls**

After the completion of the RCC raft and retaining walls up to the ground floor level, external tanking of the external surface of the retaining walls shall be carried out in the following sequence. The external tanking layer for the walls shall have an overlap over the external tanking layer provided along the brick toe wall in stage 2 and the joint sealed.

- a) A layer of red sand stone slabs/ Cuddapa slabs of approximate size 600 x 600mm and having a minimum thickness of 30mm shall be laid with a gap of 15mm between the wall and the stone. This gap shall be filled with cement slurry mixed with acrylic waterproofing compound.
- b) The joints of the stone tiles shall be inspected and any improperly filled joints shall be raked and sealed with cement mixed with the acrylic waterproofing compound.
- c) Curing shall be done by spraying water for 7 days.
- d) Thereafter a 15mm thick layer of cement mortar 1:4 (1 part cement: 4 parts coarse sand) mixed with acrylic waterproofing compound shall be splashed on the exterior surface of the stone wall, to cover the stone and joints thoroughly and uniformly.

The external tanking work for the wall shall be carried out in approved heights not exceeding 800mm and shall be taken up to heights as shown on the drawings / as directed and duly sealed with an approved silicone sealant at the top (The item of silicone sealant shall not be paid separately).

Cement slurry shall use minimum water for consistency to permit workability and floor.

The treatment of separation joints shall be undertaken as per the specifications given under clause 9.1.2 which shall be measured and paid for separately.

**9.1.2 Treatment of Separation Joints in the Basement Retaining Walls**

The exterior wall surface separation joints in the basement retaining walls shall be independently treated, and each wall and shall be sealed using approved sealant. The gap shall be provided with expanded polystyrene foam filler, duly fixed to the surface cast first with suitable adhesive and sealed using an approved Polysulphide sealant. The treatment of the separation joints shall be carried out as per the construction drawing. The work of Polysulphide sealant shall be carried out as per the specifications given under Section 19 Caulking and Sealants. Only the quantity of the Polysulphide sealant shall be measured. The bitumen felt, the sandstone used for tapping the joint etc. shall not be measured. The rate quoted for the Polysulphide sealant is deemed to include for the same.

**9.2 Waterproofing to Toilets, Kitchens etc.**

Waterproofing treatment to floor slabs and walls, chhajjas, roof projections, toilets, kitchens etc. in the building shall be done as described below:

- a) The surface shall be prepared by chipping all loose materials/ mortar cleaned with a wire brush and coir brush in order to remove all loose and deleterious matter etc.
- b) If any bores are there then the same shall be grouted using Non shrink grout SHRINKKOMP 20 or equivalent.
- c) The area to be water proofed shall be ponded with the water and leakage / dampness shall be marked in the ceiling below.
- d) Nipple shall be fixed at such locations wherever leakage persists and along the construction joints are pressure grouted using neat cement slurry and mixed with expensive grouting additive CERA EXPAN 250 or equivalent.
- e) V grooves shall be cut along concrete / Brick work junctions and construction joints, cracks and the same shall be filled with polymer modified CERA LATEX SBR Mortar or equivalent with proper coving at corners.
- f) Acrylic polymer based waterproofing system CERA LISTIC or equivalent shall be applied in two coats on cleaned surface.
- g) 20mm thick plastering shall be done with 1:4 CM and mixed with CERAPROOF IWP Liquid or equivalent at the dosage of 200mm per bag of cement.
- h) The bores shall be packed using polymer modified concrete after the pipes are laid. The treated areas shall be completed by ponding water.

### 9.3 **Water Proofing Treatment with Integral Crystalline Water Proofing Coating / Slurry:**

#### **General**

This Integral crystalline water proofing coating / slurry of hydrophilic in nature is applied to surface of the concrete to water proof and protect the concrete in-depth. It consists of Portland cement, specially treated quartz sand and a compound of active chemicals. Integral crystalline water proofing coating material needs only to be mixed with water prior to application.

When integral crystalline water proofing material is applied to a concrete surface, the active chemicals react with moisture and the by-products of cement hydration to cause a catalytic reaction that generates an insoluble, crystalline structure. These crystals fill the pores and minor shrinkage cracks in the concrete to prevent any further water ingress (even under pressure). However, integral crystalline water proofing material will still allow the passage of vapour through the structure (i.e. the concrete will be able to "breathe"). Even after the concrete has cured, integral crystalline water proofing material remains dormant in the concrete and will reactivate in the presence of moisture to seal capillary tracts and hairline cracks.

In addition to water proofing the structure, integral crystalline water proofing slurry protects concrete against seawater, wastewater, aggressive groundwater and many other aggressive chemical solutions. Integral crystalline water proofing material is approved for use in contact with potable water and is therefore suitable for use in water storage tanks, reservoirs, water treatment plants, etc.

**Material:** This Integral crystalline water proofing material consists of Portland cement, specially treated quartz sand and a compound of active chemicals.

The water proofing compound used in integral crystalline water proofing treatment shall satisfy all the requirements indicated in relevant standards or as specified in concerned relevant codes etc. and the same shall be got tested and get approved from the Engineer-in-charge before its use.

#### **Technical Specification/ Parameters:**

The integral crystalline slurry / coating material of hydrophilic in natural shall confirm to the following requirements:

1. Dosage as specified in the nomenclature of item or higher as recommended by manufacturer's specification. The material shall fulfil the requirements of American Concrete Institute Guidelines ACI-212- 3R-10 Chapter 15 or European norms EN 934-2-T2 and fall under PRAH (Permeability reducing Admixtures for HYDROSTATIC conditions) and shall be capable of withstanding/resistant to 16 bar hydrostatic pressure and reduce Coefficient of Permeability of concrete by more than 90, when compared to controlled concrete and tested as per DIN 1048 Part 5 or EN 12390-8 by carrying out 4 cycles each of 5 bar hydrostatic pressure for 72 hours and drying for 48 hours between the cycles. The co-efficient of Permeability calculated as per Darcy's Formula/ Valenta equation by incorporating penetration values obtained at the end of fourth cycle pressure.
2. It shall confirm to EN1504-3 (For structural repairs-R3, Compressive Strength >25MPa) supplied from an approved manufacturing unit having CE approval confirming to EN1504-3R3.
3. The product has no corrosion effect on reinforcement steel according to test norm DIN V18998. The maximum chloride content less than 0.1%.
4. The Integral Crystalline Slurry must be capable of self-healing of cracks up to a width of 0.5mm.
5. The crystalline water proofing coating/slurry, when used in the concrete, will have no detrimental side effects in terms of Alkali Silica Reaction (ASR), corrosion of Steel Reinforcement etc.
6. The product performance shall not be affected by wear abrasion of the treated concrete surface and crystalline treated concrete shall not require protection layer.
7. The crystalline water proofing coating/slurry shall be non-toxic and suitable for use in potable water facilities- NSF listed as per ANSI 61 listing or DVGW-W347, Germany or equivalent and a declaration of performance certificate supervised by a reputed European/US third party.
8. The manufacturer shall submit guarantee in respect of crystalline water proofing coating/slurry performance for 10 years against any leakage.

Note: The manufacturer shall submit test certificates in respect of all above said specifications/ parameters of Integral Crystalline water proofing slurry material from reputed National/International laboratories as per relevant codes.

Total quantity of the Integral Crystalline water proofing slurry material required shall be arranged at site of work only after obtaining the prior approval of the Engineer-in-Charge in writing. The proper account of water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements. The Contractor shall associate himself with anyone of the applicator of water proofing compound duly approved by the Engineer-in-Charge before start of work relating to the water proofing treatment.

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

All concrete to be treated with integral crystalline water proofing slurry material must be clean and have an "open" capillary surface. Remove laitance, dirt, grease, etc. by means of high pressure water jetting, wet sand blasting or wire brushing. Faulty concrete in the form of cracks, honeycombing, etc. must be chased out, treated with the same material and filled flush with the mortar mixture as specified by the manufacturer. Surface must be carefully pre-watered prior to the application of integral crystalline water proofing material. The concrete surface must be damp but with no wet sheen on the surface.

Mixing Integral crystalline water proofing slurry / coating material should be mechanically mixed with clean water to a creamy consistency resembling to thick oil. Only that much material should be mix as can be used within 20 minutes and mixture should be stirred frequently. The mixture should not be allowed to set, if it happens, simply re-stir to restore workability but no more water should be added to it. The ratio of integral crystalline water proofing material with water should be as below

- (i) Vertical surface: - For applying with brush the mixing ratio shall be 5 parts of integral crystalline water proofing coating material to 2 parts of water.
- (ii) Horizontal surface: - The ratio should be 3 parts of Integral Crystalline water proofing coating material to 1 part of water. This should be applied by brush only.

#### **Application Procedure:**

The slurry mix of the Integral Crystalline water proofing slurry material shall be applied in one or two coats as specified/ required according to work situation in the item. After preparation of surface as described in previous paras, and making the surface saturated with water before application of Crystalline Slurry, then first coat of the slurry mix shall be applied by the brush or appropriate power spray equipment. The second coat as specified shall be applied while the first coat is still green.

The other method of application known as dry powder consistency can also be applied on horizontal surfaces only. The specified amount of integral crystalline water proofing material is distributed in powder form through a sieve or a semi mechanical barrow spreader and trowelled into the freshly placed concrete as this reaches the initial set.

The integral crystalline water proofing material to be used shall be as following:

- (i) Vertical surface: - Two coats of integral crystalline water proofing material slurry coat shall be applied @ of 0.70 kg per sqm. per coat or more as specified by the manufacturer specification.
- (ii) Horizontal surface: - One coat of integral crystalline water proofing material slurry coat shall be applied @ of 1.10 kg per sqm or more as specified by the manufacturer specification to harden concrete. Alternatively integral crystalline water proofing material mix can be dry sprinkled @ of 1.10 kg per sqm and trowel applied to fresh concrete when it has reached initial set.
- (iii) Construction joint: - Integral crystalline water proofing material mix shall be applied either as slurry coat or dry powder consistency immediately prior to placing the next lift/ bay of concrete @ 1.60 kg per sqm. or more as specified by the manufacturer specification.
- (iv) Binding concrete: - Integral crystalline water proofing material mix shall be applied either as slurry coat or dry powder consistency immediately prior to placing the overlying concrete slab.

#### **Curing:**

The treated surfaces should be kept damp for a period of five days and must be protected against direct sun, wind and frost, by covering with polyethylene sheeting, damp burlap or similar material.

#### **Precaution / Special Consideration:**

Do not apply Integral Crystalline Slurry at temperatures at or below freezing or to frozen or freezing surfaces. Integral Crystalline slurry cannot be used as an additive to concrete or plasters. (Integral Crystalline Admixture should be considered for these applications).

#### **Storage / Shelf Life:**

When properly stored in a dry place in unopened and undamaged original packaging its shelf- life is one year.

#### **Measurement:**

The Length & breadth/height of the coated area by Integral Crystalline slurry shall be measured in metre correct to two places of decimal. Measurement shall be made in sqm of the area.

**Rate:** The rate shall include the cost of all the labour, material and equipments involved in all the operations described above.

### **9.4**

#### **Integral Cement Based Water Proofing Treatment with Brick Bat Coba:**

Before taking up the water proofing work the construction of parapet walls, including finishing should be completed. Similarly, the ancillary items like haunches, khurras, fixing up of all down take pipes, water pipes and electric conduits etc. should be completed and no such work should be allowed on the area to be treated during the progress of water proofing treatment or even later.

#### **Preparing the Surface:**

The surface of the slab should be roughened by scrapping when the slab concrete is still green, however, the surface need not be hacked. In case the slab is already cast and surface fairly finished, the same shall be cleaned neatly of all mortar droppings, loose materials etc. with brooms/cloth.

**Providing and Laying of Slurry under Base Coat:**

The quantity of water required to prepare the slurry with 2.75 kg. of blended cement to be painted over an area of 1 sqm. shall be exactly as described in clause 22.5.3 of CPWD specifications 2019.

Depending upon the area of surface that has to be covered, the required quantity of slurry should be prepared using 2.75 kg. blended cement + water per sqm. area to be covered, taking particular care to see that only that much quantity of slurry shall be prepared which can be used within half an hour of preparation i.e. before the initial setting time of cement.

The prepared slurry shall be applied over the dampened surface with brushes very carefully, including the joints between the floor slab and the parapet wall, holes on the surfaces, joints of pipes, masonry/concrete etc.

The application of the slurry should continue upto a height of 300 mm on the parapet wall and also the groove. The slurry should also be applied upto a height of 150 mm over pipe projections etc.

**Laying Base Coat 20 mm thick:**

Immediately after the application of slurry and when the application is still green, 20 mm thick cement plaster as base coat with cement mortar 1:5 (1 blended cement : 5 coarse sand) shall be evenly applied over the concrete surface taking particular care to see that all the corners and joints are properly packed and the application of the base coat shall be continued upto a height of 300 mm over the parapet wall.

**Laying Brick Bat Coba:**

Brick bat of size 25 mm to 115 mm out of well burnt bricks shall be used for the purpose of brick bat coba.

The brick bats shall be properly dampened for six hours before laying.

Brick bats shall be laid to required slope/gradient over the base coat of mortar leaving 15-25 mm gap between two bats. Cement mortar 1:5 (1 blended cement: 5 coarse sand) shall be poured over the brick bats and joints filled properly. Under no circumstances dry brick bats should be laid over the base coat.

The haunches/gola at the junction of parapet wall and the roof shall be formed only with brick bat coba as shown in Fig. 22.6 of CPWD Specifications 2019.

In case the brick bat coba is laid on the base coat immediately on initial set there will be no necessity of applying cement slurry over the base coat before laying the brick bat coba. However, if the brick bat coba is to be laid on the subsequent day, cement slurry prepared as described in clause 22.7.3 of CPWD specifications shall be applied over the top surface of the base coat, then only the brick bat coba shall be laid.

**Application of Slurry over Brick Bat Coba:**

After two days of curing of brick bat coba cement slurry prepared as per clause 22.7.3 shall be applied on the surface of brick bat coba. The application of slurry shall be the same as described in clause 22.5.3 which should cover the haunches/gola, and the remaining small portion of parapet wall and also inside the groove as shown in the figure.

**Curing and Testing the Treatment**

The entire surface thus treated shall be flooded with water by making kiaries with weak cement mortar, for a minimum period of two weeks.

**Measurement:**

The measurement shall be taken along the finished surface of treatment including the rounded and tapered portion at junction of parapet wall. Length and breadth shall be measured correct to a cm and area shall be worked out to nearest 0.01 sqm. No deduction in measurement shall be made for



openings or recesses or chimney stacks, roof lights or khurras of area upto 0.40 sqm., nor anything extra shall be paid for making such openings, recesses etc. For areas exceeding 0.40 sqm., deduction will be made in the measurements for the full openings and nothing extra shall be paid for making such openings.

**Rate:**

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

**9.5 Waterproofing and Testing**

The treated area (flat and horizontal only) shall be tested by allowing water to stand on the treated areas to a depth of 150mm for a minimum period of 72 hours.

The treated area (flat and horizontal) shall have a continuous slope towards the rainwater outlets and no water shall pond anywhere on the surface.

The roofs shall be water-tight and shall be tested on completion by flooding the roof with water to a minimum depth of 25mm for 24 hrs. Where it is impracticable, because of roof falls or otherwise, to contain a 25mm depth of water, the roof shall have water applied by a continuous hose of sprinkler system to provide a sheet flow of water over the entire area of the roof for not less than 6 hrs. In either case the roof shall be considered satisfactory if no leaks or damp patches show on the soffit. Should the structure not satisfy either of these tests, then after completion of the remedial work it should be retested in accordance with this clause. The roof insulation and covering should be completed as soon as possible after satisfactory testing.

**9.6 Protection**

The Contractor shall protect the waterproofed areas from damaged by other agencies by providing temporary catwalks at no extra cost to the Engineer.

**10 SEISMIC JOINTS/ EXPANSION JOINTS****10.1 Scope of Work**

The work shall include providing and installing sealed seismic joints for the building in accordance with the requirements and details given in the Specifications, drawings, Schedule of Quantities, together with the manufacturer's instructions, all to the complete satisfaction of the Engineer. The work shall involve sealing the Seismic joints using proprietary designed extruded seals, which may be mechanically fastened between extruded metal shapes, depending on the application. The design shall allow for joint movement in all direction and shall guard against moisture ingress. The latter shall be provided for all external joints and where directed by the Engineer. The complete details of the material proposed to be used shall be furnished to the Engineer for his approval and shall be used only after obtaining the written approval of the Engineer. The contractor shall furnish the design calculations, prepared by the manufacturer of the seismic joints, when required by the Engineer to enable the Engineer to satisfy himself regarding the suitability of the materials and adequacy of the design of the seismic joints.

The work shall be carried out under the supervision of the manufacturer/by an experienced specialist sub-contractor who shall be appointed only after prior approval of the Engineer.

**10.2 Materials**

The seismic joint materials shall be procured from an approved manufacturer such as Watson Bowman Acme Corporation, represented by Sanfield (India) Pvt. Ltd. or an approved equivalent.

The material shall conform to the following codes/publications.

- a) Aluminium Extrusions shall conform to ASTM B221. The alloy shall be either 6061-T6 or 6063-T5.
- b) Aluminium sheet and plates shall conform to properties of ASTM B209. The alloy shall be either 6061-T6 or 6063-T5 or 5052-H32.
- c) Steel shapes shall conform to ASTM-A588.
- d) Stainless steel shall conform to ASTM-A-204 GR304 or ASTM-A-479 GR 304.
- e) Bronze Extrusions: Material shall be Architectural Bronze 385 Alloy.
- f) Elastomeric Compression Seal: These shall be neoprene compound with a Durometer Type 'A' Shore hardness of 55±5 and a tensile strength of 2000 psi and shall conform to ASTM D-2628.
- g) Moisture Barrier shall be vinyl moisture barrier as recommended by the joint manufacturer or an approved equivalent, all as subject to the approval of the Engineer.
- h) Thermal Plastic Rubber shall be as per the manufacturer's standard, subject to the approval of the Engineer.
- i) Fire rated joint system shall have independent laboratory test reports reflecting the endurance result of the materials run to ASTM-E-119 time temperature curve.
- j) Elastomeric Joint Systems: The elastomer shall comply with U.S. Federal Specification - TT-S-0027-E (3) with a Shore A hardness of 25 and allow movement of ± 35% joint movement. The choice of colour within the range of colours offered by the manufacturer shall be done by the Engineer. The Elastomer shall be applied in the factory to pre-treated Anodized Aluminium retainers with continuous retainer legs. All corners shall be prefabricated. Blockout installation shall be provided at site by the Contractor as per the dimensions given by the manufacturer.
- k) Lubricant adhesive used shall be a one-part moisture curing polyurethane and aromatic hydrocarbon solvent mixture and shall conform to ASTM D4070.
- l) Visual Seal shall be dense neoprene with a Durometer Shore "A" hardness of 70±5 and in accordance with ASTM C-864 or thermoplastic rubber with a Durometer Shore A hardness of 73 ± 5 in accordance with manufacturer's standard physical properties.
- m) Functional seal shall be flame retardant vinyl material.
- n) Sealant shall be a one-part Polysulphide base synthetic rubber sealant conforming to Federal Specifications TT-S-00230C Type 11.
- o) The Contractor shall provide all necessary accessories, related parts, devices, anchors etc. required for completing the installation.

### 10.3 **Fabrication**

Aluminium sections shall have factory-drilled holes spaced as per manufacturer's recommendation. Extrusions shall be miter cut at the site to suit directional changes.

Extrusions shall be supplied to site in their original packing in lengths as fabricated to suit the building dimensions.

Steel shapes shall be supplied in lengths as fabricated to suit the building dimensions.

Aluminium sections shall have mill finish unless otherwise specified.

Steel sections shall be blast cleaned at site prior to the installation of the neoprene seal. The cleaned metal surfaces which come in contact with the seal shall be protected against rusting till the seal and the adhesive are placed against the metal surface.

The details of the finished colours offered by the manufacturer for Stainless Steel and Electrometric components shall be furnished to the Engineer to enable him to exercise his choice.

### 10.4 **Execution**

The seismic joint system shall be installed strictly as per the manufacturer's instructions and as directed by the Engineer.

The seismic joint system shall be adjusted to the proper widths for the ambient temperature at the time of installation.

The Contractor shall prepare all surface and/or recesses for mounting Aluminium extrusions. The surfaces must be flat and smooth. The variations in surfaces affecting joint installation shall not be permitted and shall be corrected prior to installation.

All the surfaces to receive the joint system shall be free from dirt, water, frost and any other loose foreign debris, which may be detrimental to effective joint system.

At each joint location the metal extrusions shall be installed first. The seal element shall be installed subsequently in one continuous piece. If any field cutting/mitring of the seal shall be done to accommodate directional changes, the same shall be replaced using adhesive recommended by the manufacturer. The joint to be sealed shall be prepared by removal of any foreign materials and patching of any spalled areas so as to give a neat clear joint with uniform gap.

For the compression seal the lubricant adhesive recommended by the manufacturer shall be applied continuously to the inner phase of the clean joint. Armoured block out shall be provided for fixing compressive seal. The bottom portion of the seal shall be compressed and inserted into the joints and position within it to the proper depth with the aid of an installation tool.

#### 10.5 **Cleaning and Protection**

The work shall be protected with the manufacturers specified standard protective paper. The same shall be removed from the exposed trim piece after finish work in adjacent areas are completed. The exposed surface shall be cleaned with a suitable cleaner which shall not harm the factory applied finishes.

Compression seal shall be protected from damage during construction of adjacent areas until completion of the structure. The excessive adhesive from the exposed surfaces of the compression seal shall be cleaned with a solvent cleaner as recommended by the manufacturer.

#### 10.6 **Delivery, Storage and Handling**

The product shall be delivered to the site in each manufacturer's original, intact, labelled containers and stored under cover in a dry location until installed. The products shall be stored off the ground and shall be protected from weather and construction activities.

The exposed trim pieces of the joint system shall be delivered to the site in a manufacturers standard protective paper or wrapping.

#### 10.7 **Shop Drawings**

The Contractor shall prepare shop drawings to inter alia show the outline of the structure as built and the manner in which the seismic joints are to be provided. The shop drawings (template drawings) shall also show typical expansion joint cross-sections indicating all pertinent dimensions, general construction, component connections, anchorage methods and hardware locations.

#### 10.8 **Acceptance of Work**

##### 10.8.1 **Periodic Acceptance of Work**

The work shall be checked periodically at the end of each stage of installation, before commencement of the next stage. Any work found to be not acceptable vis-a-vis tolerance, lines, levels, finish, etc. shall be rejected, removed and replaced before proceeding with further work.

##### 10.9 **Final Acceptance of Work**

The final acceptance shall only be accorded once the entire work is complete in one area of the building; after all other works as per this Contract have also been duly completed and accepted.

The Contractor shall ensure that the joints are so installed that they prevent rainwater from reaching to the inside. All units and joints between units shall be designed to prevent ingress of water by capillary.

The Contractor shall ensure that the risk of attack or infestation by micro-organisms, fungi, insects and other vermin is minimal and also that there is no risk of ingress of vermin into the building.

#### 10.10 **Protection**

The contractor shall protect all work until handing over. Special protection as directed shall be provided for floor joints to prevent them from being damaged due to execution of other works either under this Contract or those of other agencies damaging the joints or marring their appearance and finish.

### 11 **CAULKING AND SEALANTS**

#### 11.1 **Scope of Work**

11.1.1 The work shall include providing caulking and sealants for expansion/ separation/ construction/ movement joints, gaps between similar and dissimilar materials etc. and at any other location and situation as directed by the Engineer, in accordance with the design, patterns, shapes, thickness, details, all as shown on the "Construction" drawings or as specified or as per the manufacturer's instructions all as directed by the Engineer complete in all respects to give the quality of finished work as desired by and to the entire satisfaction of the Engineer.

11.1.2 The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the Engineer.

#### 11.2 **Materials**

##### 11.2.1 **Caulking and Sealants**

11.2.1.1 Caulking and sealants shall be as follows:

- a) Work below ground level and/or in contact with water: One part gun-grade Polysulphide sealant conforming to BS: 5215. The sealant shall be of an approved color and shall be non-staining to the stone for cladding.
- b) Work above ground level: One part gun grade silicone sealant conforming to BS: 4254: 1983 or ASTM C920- 87, Type M, Grade-NS, Class 25 such as Thioflex- 600 or any other approved equivalent. The sealant shall be of an approved colour and shall be non-staining to the stone for cladding.

##### 11.2.2 **Ancillary Materials**

11.2.2.1 The Contractor shall provide all ancillary materials such as cleaning solutions, epoxy mortar, primer, tool cleaner, bond breaker tape, filler boards, back up material, backing rods, polyethylene foam, masking tapes, sealant slot former etc.

##### 11.2.3 **Primer**

11.2.3.1 Primer for sealants shall only be as recommended by the sealant manufacturer. Primer shall have been tested for compatibility and durability with the sealant to be used and on samples of the surfaces to be selected.

##### 11.2.4 **Backdrop Material**

11.2.4.1 Backdrop material shall be an expanded polyethylene of nominal density 35 kg/cum as recommended by the sealant manufacturer. It shall be of non-absorbent and non-staining material compatible with the sealant used. Tube or rod stock shall be rolled into the joint cavity.

**11.2.5 Bond-preventive Materials**

Bond-preventive materials shall be pressure-sensitive adhesive polyethylene tape or Aluminium foil.

**11.3 Equipment**

The Contractor shall inter alia provide the following plant and equipment for the work.

T-paddle, follower plate, solid barrel gun, plastic nozzle, wire brush, heavy duty 500 rpm electric drill, palette knife, masking tape and paint brush for priming etc.

**11.4 Handling Precautions**

11.4.1 Uncured material shall be prevented from coming into contact with the skin. Protective clothing, goggles, barrier creams and rubber gloves shall be used as and where required. At the end of each working period the skin shall be thoroughly cleaned with soap and warm water for a resin removing cream. Solvents shall not be used for cleaning the skin. Proprietary skin cleaners may be used. The manufacturer's recommendations and precautions shall be adhered to.

**11.4.2 Health and Safety**

11.4.2.1 For specialist advice on material health and safety data reference may be made to the manufacturer's data.

**11.5 Working Life**

Care shall be taken to ensure that material with adequate shell life is provided. Material whose shell life is over shall not be used in the works and shall be removed from the site forthwith. Depending on the storage, temperature and humidity, only one unit shall be drawn from the storage.

**11.6 Curing Period**

No portion of the work where sealant has been applied shall be allowed to be submerged or be wetted by any liquid for a period of 7 days after application of the sealant. This period may be modified depending on the temperature and humidity prevalent at the time.

**11.7 Recommended Movement**

11.7.1 The sealant shall be capable of withstanding the movement as per the codes.

**11.8 Colour**

11.8.1 The colour of the sealant shall be as per the manufacturer's data sheet or colour chart and shall be as approved by the Engineer

**11.9 Environmental Requirements**

11.9.1 The ambient temperature shall be within the limits as given by the manufacturer, when the caulking and sealants are applied. The work shall not be carried out in a dusty atmosphere or when it is raining or when the humidity is high.

11.9.2 Caulking and sealants shall not be applied when the ambient temperature is below 4-degree C. When the ambient temperature is below 10-degree C but greater than 4-degree C, the sealant containers shall be stored for some hours at 21-degree C, to ease mixing and application.

**11.10 Delivery and Storage**

11.10.1 Materials shall be delivered to the job site in the manufacturer's original unopened containers.

11.10.2 The containers shall include the following information on the label:

- a) Name of supplier,
- b) Name of material,
- c) Formula,
- d) Lot number,
- e) Colour,
- f) Date of manufacture,
- g) Mixing instructions,
- h) Shell life and
- i) Curing time.

11.10.3 Materials shall be carefully handled and stored to prevent contamination of foreign materials to exposure to temperatures exceeding 35-degree C.

#### 11.11 Joints

11.11.1 The effective width to depth ratio shall be as per the table given below unless directed otherwise by the Engineer.

**Table – 20.1**

Surfaces	Joint Width	Joint Depth	
		Minimum	Maximum
For metal, glass or other nonporous surfaces:	6mm	6 mm	6 mm
	Over 6mm	½ of width	Equal to width
For concrete masonry or stone:	6 mm	6 mm	6 mm
	Over 6mm up to 12mm	6 mm	Equal to width
	Over 12mm	½ of width	½ of width

#### 11.12 Surface Preparation

##### 11.12.1 General

11.12.1.1 The surface of joints to be sealed shall be clean, dry, sound and free of all release agents, water repellents, laitance, oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scales, glazing compounds, protective coating, old sealants, and other foreign substances. Oil and grease shall be removed with solvent and the surfaces shall be wiped with clean clothes.

##### 11.12.2 Concrete and Masonry Surfaces

11.12.2.1 Where surfaces have been treated with curing compounds, oil or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity. The surfaces / edges shall be repaired with epoxy mortar to give smooth and even surfaces to correct lines and levels with a uniform gap for the length to be sealed.

##### 11.12.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted if sandblasting is not practical or would damage adjacent finish work, the metal shall be scrapped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

#### 11.13 Application

##### 11.13.1 Masking Tape

- 11.13.1.1 Areas adjacent to joints shall be masked to ensure neat sealant lines. Masking tape shall not be allowed to touch clean surfaces to which the silicone sealant is to adhere. Masking tape shall be placed on the finished surface on one or both sides of a joint cavity to protect adjacent finished surfaces from primer or compound smears. The masking tape shall be removed within 10 minutes after the joint shall be filled and tooled. Tooling shall be completed in one continuous stroke immediately after sealant application and before a skin forms and masking shall be removed immediately after tooling.
- 11.13.2 **Tolerance:**  
A tolerance of + 3 mm shall be allowed in the width of silicone joints. The depth of the joints at throat shall not be less than 6 mm.
- 11.13.3 **Bond-preventive materials**
- 11.13.3.1 Bond-preventive materials shall be installed on the bottom of the joint cavity and other surfaces to prevent the sealant from adhering to the surfaces covered by the bond-preventive materials. The materials shall be carefully applied to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond-preventive materials.
- 11.13.4 **Backstops**
- 11.13.4.1 The back or bottom of joints constructed deeper than specified shall be packed tightly with an approved backstop material to provide a joint of the depth specified. Where it is necessary to provide a backstop of a caulking compound, the joint shall be tightly packed.
- 11.13.5 **Primer**  
The primer shall be used in accordance with the manufacturer's instructions. The primer shall be applied to the joint surfaces to be sealed only and not spill over or be applied to surfaces adjacent to the joints.
- 11.14 **Application of Sealant**
- 11.14.1 The sealant shall be gun-applied with a nozzle of proper size to fit the width of the joint indicated and shall be forced into grooves with sufficient pressure to expel air and fill the groove solidly. The sealant shall be uniformly smooth and free of wrinkles.
- 11.14.2 The plastic nozzles shall be inserted on the gun and cut to appropriate size. The sealant shall be gunned into joints using an even trigger pressure. The nozzle shall be cleaned occasionally.
- 11.14.3 The sealant shall be pressed into joints with a wet spatula and tooled within five minutes of application. The jointly shall be tooled slightly concave after the sealant is installed. The tooled joint shall present a smooth and professional joint giving the desired finish and shape.
- 11.14.4 The masking tape shall be removed immediately after tooling.
- 11.14.5 Application equipment shall be cleaned with a tool cleaner, recommended by the manufacturer, after wearing PVC or rubber gloves and whist the sealant is still in an uncured state
- 11.14.6 **Cleaning**
- 11.14.6.1 The surfaces adjoining the caulked and sealed joints shall be cleaned of smears and other soiling resulting from the caulking and sealing application as the work progresses. Sealant adhering to, porous surfaces shall be left until is just cured and then removed by abrasion or other mechanical means.

**12 MISCELLANEOUS WORKS****12.1 Plastering Mesh**

The materials shall be of Arpitha make or approved equivalent. Plaster mesh 150 mm wide manufactured out of hot dipped galvanized iron of nominal thickness 0.35 mm with zinc coating of 120 gms per Sqm width along route of walls chipped for services, junctions between RCC and brick wall or any two different materials is to be used.

**12.1.1 Applications**

For Chasing works done for Electrical conduits and water lines, discretionary methods are to be used for selection of the widths of the mesh so that extra 50 mm width of plaster mesh runs on either side of the chasings. The nailing has to be 300 mm apart. Very importantly the mortar has to be compacted in the spaces in between pipes, conduits and chasings before the plaster mesh is fixed. A high quality plaster mesh (expanded galvanized iron metal) for primarily as an anti-cracking reinforcements in plastering of wall beam and wall column joints to avoid cracks is to be used.

**12.1.2 Measurements**

Length to the nearest cm. and overall should be calculated in Rmt correct to two decimal places.

**12.1.3 Rates**

Rates are including cutting and providing mesh including all labour charges for fixing.

**13 SITE DEVELOPMENT AND HORTICULTURE WORKS****13.1 Scope**

The scope of work covered by this section of the specification shall include, required ground preparation after site grading, provision and spreading to top soil, provision and planting of trees, shrubs, ground cover and lawns.

**13.2 Materials****13.2.1 Top Soil/Good Earth**

Topsoil shall be fertile agricultural soil, free from foreign matter like building rubbish etc. non-saline and non-alkaline a sandy loam with the following particle distribution:

Sand	2mm - 0.05 mm	55	-	66%
Silt	0.05mm – 0.002 mm	25	-	30%
Clay	Less than 0.002 mm	10	-	15%

Topsoil material shall comply with the following chemical characteristics:

PH	6.0 – 7.5 Saturated soil.
Conductivity	2mm hos Saturated extract.
Free carbonates	0.5% Air-dried soil.
Chlorides	200 ppm Saturated extract.
Sulphites exchangeable	200 ppm Saturated extract.
Sodium q15%	Neutral normal ammonium acetate.
Nitrates	75 ppm Saturated extract.
Phosphorus	10-25 ppm 1:5 sodium bicarbonate extractant (30 min. shake).
Potassium	100-400 ppm 1:5 ammonium nitrate extractant (30 min. shake).
Baron	1.5 ppm Hot water soluble.

One test per 50 cum of soil shall be carried out for particle size analysis, pH value and conductivity. Other constituents shall be tested at the rate of one test per 500 cum. of soil.

**13.3 Growing medium**

Growing medium shall consist of top soil as defined above plus soil additives as specified.



- 13.4 **Manure/Sludge/Compost**  
Manure shall be well rotted, unleached animal dung with not more than 15% vegetable matter, farm yard manure. It shall be from an approved source and shall be disease and pest free.
- Peat**  
Peat shall be of the sphagnum moss variety and coarsely shredded from an approved source. It shall have pH value between 3.3 and 6.0 at 25 deg.C. fine peat moss is not acceptable.
- 13.5 **Grass Seed or Sods**  
Grass seed or sods shall be 100% bermuda grass seed or sods shall be fresh when supplied and shall be obtained from an approved source, together with a certificate giving the name of the supplier and quoting the certified percentage of purity and generation. Approval of the sods/seeds and source shall be obtained before the order is placed.
- 13.6 **Grass Mulch**  
Gravel mulch shall consist of clean well-rounded gravel pebbles with maximum nominal diameter of 38 mm.
- 13.7 **Anti-Desiccant Spray**  
If used, this shall be of an approved type mixed and applied in accordance with the manufacturer's recommendations.
- 13.8 **Polyurionide Compound**  
This shall be of an approved type mixed and applied in accordance with the manufacturer's recommendations.
- 13.9 **Superphosphate Fertilizers**  
This shall be a single superphosphate with minimum content of 18% P2O5.
- 13.10 **Water**  
Watering shall be carried out with fresh water with electrical conductivity test that 2 milliohms/cm at 25 deg.C. and sodium chloride content less than 500 mg/litre. Water samples shall be tested at approved laboratories and the test certificates forwarded to the Engineer.
- 13.11 **Plant Containers**  
Plant containers shall be of tin, clay, PVC or other approved material and shall have drainage holes. They shall be capable of easy removal to avoid damage to the plant or root ball, and shall be of sufficient size for the plant material contained therein.
- 13.12 **Stakes and Ties**  
Tree stakes shall be used for all trees and shall be round debarked hardwood 3.0M long, treated with a non-toxic wood preservative like creosote with 3 required for each tree. Stakes shall be driven 200mm below the bottom of tree pits and made from and located to provide good support to all sides of the tree when planted.
- Trees ties shall be of rubber or fabric webbing and 25mm wide minimum. Ties shall be provided with a buffer piece to ensure that the tree, when planted, at no time touches the stake. All ties shall be of sufficient length to allow for the size of the tree and for adjustments that will need to be made up to such time as the tree no longer requires support. Three ties per tree shall be provided sufficient to ensure that the tree cannot touch the stakes. The ties to be tied to tree or shrubs saplings in a figure of eight.
- 13.13 **Neam/Castor Cake**  
The cake shall be free from grit, and any other foreign matter. It should be undecorticated and pulverized. The cakes should be got from an approved source.

**13.14 Trees**

Trees shall be minimum mature size 2 metre high as noted on landscape plan with a well formed balanced head, strong leader and a clean straight trunk and located to provide good support to all sides of the tree when planted. The tree saplings to have well developed root and shoot system.

Trees shall be provided with tree guard and shall be staked.

**13.15 Shrubs & Creepers**

a) A large shall have all the following characteristics:

- A seeding or rooted cutting that has been transplanted and which has a bushy habit.
- Bushiness encouraged by pruning with a minimum of three one year old vigorous shoot well.
- Furnished to produce a diameter two-thirds of the height.
- A height as noted on plans or 1 M high.

**13.16 Ground Cover Plants**

a) A ground cover plant shall have all the following characteristics:

- Well-developed vigorous shoots.
- A well-developed vigorous root system.
- Length of minimum 0.4 M long or as noted in planting-plan.

**13.17 Tree Guards**

Tree guards shall be of mild steel or made of bricks as directed by Engineer, 1.6 m above the ground level.

**13.18 Interlocking Block Paving Works****13.18.1 Quality**

The block for the paving works shall be of approved quality and make. The blocks shall be 60 mm thick having and the specified size and type and grey or red or combination of them.

**13.18.2 Sub-base and Base**

Over the prepared and consolidated sub grade a layer of sub-base using crushed aggregate shall be laid to falls and slopes to a compacted thickness of 100 and compacted with C-10 tonne roller. Over the prepared sub-base, a layer of 3mm and down fine sand shall be laid to a thickness of 50 mm and accurately screed and levelled and compacted to 38 mm in thickness and to required falls and slope to the satisfaction of the Engineer.

**13.18.3 Layers**

The blocks shall be laid on top of the prepared base in required pattern as directed by the Engineer. On completion of the laying work, approved fine screened sand shall be spread over the paving and the joints filled with fine sand and compacted as directed by the Engineer. Extra sand on the surface shall be removed by brush. When required, edge blocks shall be cut clear and sharp with approved tools and as per manufacturer's instructions. The cut edges shall be rubbed smooth before laying. Compaction with a power vibrating plate (wacker model VPH 70) shall be used suitably as recommended by the approved proprietary manufacturer. Any blocks damaged during laying shall be replaced. The entire work of the installation and materials shall meet the approval of the Engineer.

**13.19 Yellow Strip**

**13.20 General**

Plastomark Thermo plastic hot applied road marking paint (yellow or white) of thickness 2mm of STP Limited make or equivalent as per BS 3262 (Part I & Part II with up to date amendments) shall be laid on flame finished granite/Kota/bituminous road surface with the help of self-propelled applicator machine providing 100mm/75mm wide uniform marking of paint as required.

**13.20.1 Container**

Each bag containing materials shall have clear marking as follows:

- a) Manufacturer's name and place.
- b) Batch number.
- c) Date of manufacture.

**13.20.2 Preparation**

Solid block of silica sand and crushed calcite aggregate, extender (calcium carbonate), pigments (Titanium dioxide as per BS 1831) and thermoplastic hydrocarbon resin binder plasticised with mineral oil shall be mixed proportionately as per manufacturer's printed instruction to form uniform slurry/paste and put them into melter for heating. The temperature shall be raised gradually to 170°C with the gas fire and to be kept constant. The material in the container shall be stirred thoroughly by hand stirrer from time to time to keep the material homogeneously mixed and consistent.

**13.20.3 Laying**

Dust, sand, oil, grease, etc., shall be removed from the road surface and the road surface shall be absolutely clean before application of paint.

First the lines shall be drawn on the granite or asphalt base by help of string marker (a string coated with white chalk or powder) and the nylon cord shall be nailed on the lines marked by chalk. The marker or applicator machine shall be kept parallel to the nylon cord. The hot material shall be poured to the dragging shoe of the applicator machine and pushed slowly. Simultaneously the soda glass beads of special shape and free from flaws shall be spreader from glass dispenser to the hot applied thermoplastic paint uniformly at the rate of minimum 250 gm per square metre. Then the material shall be left protected, till dried and set properly. The traffic can be opened after one hour minimum of application.

In case of granite a coat of special primer shall be applied before laying of thermoplastic paint. Markings shall be free from raggedness at their edges and shall be uniform and free from streaks.

**13.21 Cement concrete Designer Tile****13.21.1 Material**

The cement concrete designer tiles will be Eurocon tiles or equivalent for flooring of nominal sizes 416mm x 416mm, 361 mm x 361mm or as specified by the Engineer in charge. The sizes of the tiles to be used shall be as shown in the drawings or as required by the Engineer in charge. Step tiles are to be provided as shown in the drawings.

**13.21.2 Quality**

The tiles shall conform IS: 1237: 1980 Specifications. The overall thickness of the tiles shall not be less than 22mm. The weight of the floor tile shall not be less than 4.5 kg per Sqft.

**13.21.3 Laying, finishing and curing**

The tiles shall be laid on a flat surface or sloped surface as indicted in the drawings using cement mortar as specified and as per the instructions of the Engineer in charge. The tiles joints shall be grouted with pigment of same colour as that of the tiles. The tile works shall be cured for a minimum period of 7 days.

**13.21.4 Handling and Storage**

The contractor shall ensure that the same colour of the tiles is used. Any damaged tiles or faded tiles shall be replaced or returned.

**13.21.5 Measurements**

Tiles flooring shall be measured separately and in square meter correct to two places of decimal. Length and breadth shall be measured correct to a cm before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 square meter. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square meter. Nothing extra shall be paid for laying the floor at different levels in the same room.

**13.21.6 Rates**

The rate shall include the cost of all the materials and labours involved in all the operations described as above.

**14 LIST OF APPROVED MANUFACTURERS**

14.1 All materials and products shall conform to the relevant standards/specifications of IS code, BS Code etc. and shall be of approved make and design. A list of manufacturers / vendors is given in appendix 10 for guidance. The approval of a manufacturer/vendor shall be given only after review of the sample / specimen by the Engineer. The complete system and installation shall also be in conformity with the Clause – 1.6 – “Applicable Codes, Standards and Publications”.

14.2 List of approved makes for products and materials is given below. Other equivalent manufacturers may be considered with prior approval

**15. MECHANICAL, ELECTRICAL & PLUMBING WORKS****15.1 General**

15.1.1 The Contractor shall only use the approved materials as indicated in the Employer's Requirements duly approved by the Engineer.

15.1.2 The Contractor shall develop the design and select equipment based on technical specification and on sound, proven and reliable engineering practices. The broad design / selection criteria shall be submitted with technical support data in the technical proposal. Detailed calculations shall be submitted to the Engineer during the design process for review and approval.

15.1.3 The Contractor shall ensure the correct selection of the make meeting the design specifications and application duty. The technical submission made by the Contractor shall clearly indicate deviation or improvements if any, for specifications. Before placing order for procurement, the Engineer may ask for the sample of proposed make to be verified for its suitability to the specifications and application duty. However, in case the Engineer considers that the make/model proposed by the Contractor does not meet the requirement, the Contractor will be required to propose an alternative make acceptable to the Engineer. The decision of the Engineer in this regard shall be final and binding on both parties.

**15.1.4 Vendor approval policy**

- a. It shall be obligatory for the Contractor to obtain Notice of 'No Objection' from the Engineer for the vendors identified / selected for all items of work, even if the name of the vendor is specified in the tender and the works to be done including purchase of materials and equipment in accordance with the Standards specified in the Contract.
- b. While selecting the Vendor, due care is to be taken to ensure that the vendor is capable in providing good “after sales services” in during two years Defect Liability Period (DLP) and subsequently during the life of the item / equipment, thereafter.

**15.1.5 Vendor Approval and Selection Procedure**

- a. The contractor shall submit the Vendor proposal for all the equipment / systems to be supplied in

the contract in accordance with the tender requirement for obtaining “No-Objection” from the Engineer. The contractor shall submit the proposal for the vendor after ensuring that the proposal meets the specifications in line with the quality and safety standards of the proposed makes. The proposed product should be a proven one. The Contractor shall also stand full guarantee to his proposal and if at any stage it is found that the material is not suitable or meeting the tender requirement, the contractor shall replace the material and provide the material from the alternate vendor after approval from Employer without any additional cost to Employer. The alternate makes can be used only after an approval has been accorded by the Employer, whose decision will be final in the matter.

- b. The approval of vendor for any equipment / product shall be done in two stages:-

i. Stage-I

Assessment of capability of proposed Vendor to supply a particular equipment or product, with quality and performance requirements, as required by Specifications as well as other contract conditions. The proposed product should be a proven product in service for at least 3 years in similar working environment or as specified in contract specifications.

Assessment of the financial and functional strength of the Vendor to supply the requisite quantity of equipment and product as per delivery schedule acceptable to the contractor and the Engineer to deliver the project in time.

ii. Stage-II

Stage-II called as Technical Approval Stage, selection of Equipment or product from the equipment / products / model being manufactured / supplied by the approved vendor will be done. This stage includes thorough technical assessments about the conformance of the offered equipment / product / model to the Specifications and other requirements of the contract.

- c. Before placing the order for procurement, the sample of approved make shall be verified for its suitability to the specification and application. In case the Engineer, (whose decision will be final and binding on both parties) considers that the make / model proposed by the contractor does not meet the tender requirement, the contractor will be required to propose an alternative make acceptable to the Engineer.
- d. To obtain Vendor Approval, the Contractor must submit the request with the following minimum documents along with duly filled with Vendor Approval Checklist.
- i. Company Profile and Experience of the Vendor
  - ii. Clause wise compliance of the relevant Specifications.
  - iii. Details of supplies / orders executed in last five years for the type of equipment / product offered. Supplies / orders executed for Elevated/Underground Metro / Suburban / Railway Systems shall be specifically mentioned.
  - iv. Details of the facilities available at the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured.
  - v. ISO 9000 Certification for the Works / Manufacturing Unit where the proposed equipment / product shall be manufactured (The Works / Manufacturing Unit where the proposed equipment / product shall be manufactured must have ISO 9000 Certification)
  - vi. Proof regarding compliance to Manufacturer's Qualifications. The offered products must be proven in service in similar environment i.e Metro / Railways or Airport.
  - vii. Audited Financial Statements of the Vendor for the last three years.
  - viii. Type test certificates / Performance certificate from accredited laboratories for the proposed type of equipment / products as specified in contract specifications to establish the technical capability of the vendor (In case, specific requirements are mentioned in the relevant sections of Specifications with regard to type testing, same shall also be complied additionally).
  - ix. The vendor shall not have been blacklisted by any Govt. Agency in India during last 5 years.

- e. Undertaking for submission of tripartite warranty Agreement duly signed by the authorized signatory of the supplier / vendor and Contractor to the Engineer / Employer within 30 days after signing of subcontract / vendor agreement between the Contractor and the subcontractor / vendor.
- f. Any other item as required by Employer / the Engineer, the Contractor must be included/certified in the check list, that the vendor Proposal is complete and all the above documents are available in the Vendor Proposal. In addition, the Contractor must check / certify compliance to the Specifications before forwarding the same.
- g. Incomplete Vendor Proposal shall not be treated as a submission and will be returned. For all the proposed vendors, the contractor shall submit details of Major subcomponents / system which is outsourced / "bought out" item for the proposed main equipment vendor. The Employer (if required) may ask details for granting specific vendor approval for the source of sub-component, which shall be submitted along with the vendor proposal for the main equipment / system.
- h. The contractor shall submit along with the vendor proposal the commitment for Reliability, Availability and Maintainability requirements in terms of MTBF (Mean Time Between failure), FRPCPY (Failure Rate Per Cent Per Year) and MTTR (Mean time to Repair), etc. from the manufacturer of the proposed equipment / major subcomponent. These proposed / committed parameters shall be reviewed during the Defect Liability Period (DLP).
- j. If it is found that the parameters are not being complied, then the Contractor / vendor shall be bound to either replace the complete equipment / sub system OR carry out necessary modifications in the equipment / sub-system to meet the performance parameters.
- k. The Engineer shall issue "No-Objection" to the Vendor Proposal (received complete with all the documents mentioned above) after detailed scrutiny.
- l. It may be noted that Approval of Vendors shall only be done by the Employer / the Engineer after the award of the work. Vendor submissions shall not be evaluated during the tender evaluation. Conditional Tender offers received from Tenderers with particular Vendors for supply of equipment / products will not be evaluated during evaluation and will be dealt with after award of the work.
- m. For obtaining "No-Objection" on the Vendor Proposal, the Contractor must submit technical submission accompanied with the calculations / other technical documents to justify the selection of any particular model of equipment / product, detailed technical features / parameters of the selected product, type test certificates as specified in contract specifications from the accredited laboratories for the offered products, any other document required by the Engineer.
- n. It may further be noted that Employer / Engineer shall be under no obligation to accept equipment / products manufactured by the successful Tenderer, unless it meets the entire criterion mentioned above.
- o. In addition to the above, the following shall also be ensured for the Vendor Approval and Selection:
  - 
  - i. Proven Design:  
The Contractor shall develop the design based on the contract specifications and on sound proven and reliable engineering practices. The broad design details shall be submitted with technical support data in the technical bid. Detailed calculations shall be submitted to the Engineer during the "design process" stage for review and approval.
  - ii. Systems and Sub-Systems
    - Manufacturer shall have at least 5 years' experience of design and manufacturing of similar system. Proposed systems from the proposed manufacturing unit shall have been in use and have established their satisfactory performance and reliability for 3 years in minimum in metro / railways or Airport.
    - All sub-systems, equipment and major components etc. (hereinafter referred as 'sub-systems') shall be state-of-art and of proven design.
    - Proposed Systems/ sub-systems shall have been in use and have established their

satisfactory performance and reliability on at least Two mass rapid transit systems (including Metro/ Railways or Airports) in revenue service over a period of three years or more either outside the country of origin or on an average in two different countries.

- p. Systems / Sub-systems / components used in other MRTS in India do not get automatically qualified for use unless specifically approved by the Engineer for this project. If required by the Engineer, Contractor shall provide certificate of satisfactory performance for a period of five years or more from the Metro(MRTS) operators /Suburban / Railway, where similar System/ Sub-systems of a different rating are already proven in service as per the above criteria then the supply shall be based on such subsystems. All 'sub systems' shall be procured from the approved vendors and sourced from only such manufacturing units those have supplied the sub-systems that fulfil the proven design requirements as above.
- q. The Engineer/Employer may ask the Contractor/ vendor to get the equipment, components and parts to be incorporated in the metro(MRTS) / Suburban / Railway system, tested in certified laboratories (designated by the Govt. of India) to check for any kind of embedded malware / trojans / cyber threat and for adherence to Indian standards. The Contractor and the vendor shall be required to get the test conducted without any extra cost to Employer, and submit its report. Contractor / Vendor shall inform the dates and location of test at least 15/30 days in advance to the Engineer.
- r. For sourcing the equipment from indigenous manufacturing facilities, following conditions shall be complied: -
  - i. In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, no change in design, component type / make, quality standards, manufacture procedure, etc. shall be made without specific approval of the Engineer.
  - ii. In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from Employer. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub- assemblies of such equipment as manufactured by the approved parent vendor, shall be made without specific approval of the Engineer.
  - iii. In both the cases (i) and (ii) above, the first article manufactured indigenously shall be Type tested as per relevant standards before starting bulk manufacturing. The Approved parent vendor shall also submit Triparty warranty agreement as per Annexure-B, for ensuring that full technical support is extended to Employer / contractor during project execution and also during DLP and 5 years beyond DLP.
  - iv. In case OEM wishes to change/make/type specifications, etc. of any subcomponents for supplies to be sourced from Indian facility, specific prior approval of the Engineer shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the contractor.
- s. For obtaining "No-Objection" of subcontractor for the electrical works, the contractor shall submit subcontractor's proposal in accordance with the (Checklist for the Subcontractor Proposal for Electrical Contracts). However, in case the proposed subcontractor is also a supplier of the equipment / material then the vendor proposal in accordance with the above procedure shall also be submitted for obtaining "No-Objection".
- t. Payment against the delivery/installation/completion/testing & Commissioning of MEP items, as per "Section 9 and shall be as per site progress and as approved by the Engineer.
- u. The Contractor to submit PO Copy /Invoice of Each item to verify Correct selection / procurement of Vendor / material is made by the Contractor. The Contractor shall take prior approval before delivery of items at site.

- i. In case the Contractor has to use systems or sub-system(s) that do not fulfil the above said criteria, then the Contractor shall furnish sufficient information to prove the basic soundness and reliability of the offered systems and sub-system(s) for review of the Engineer. The Engineer's decision on Contractor's proposal shall be final and binding.