

MATERIALS SPECIFICATIONS – CIVIL WORKS**M-1 Water:**

- 1.1 Water shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil and injurious alkalies salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in RCC container for transport, storage and handling of water shall be clean. Water shall conform to the standards specified in IS : 456.
- 1.2 If required by the Engineer-in-charge it shall be tested by comparison with distilled water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in IS : 269. Any indication of unsoundness change in time of setting by 30 minutes or more or decrease of more than 10 per cent in strength of mortar prepared with water sample when compared with the results obtained with mortar prepared with distilled water shall be sufficient cause for rejection of water under test.
- 1.3 Water for curing mortar, concrete or masonry should not be too acidic or too alkaline. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces.
- 1.4 Hard and bitter water shall generally be found unsuitable for curing mortar or concrete.
- 1.5 Potable water shall be generally found suitable for curing mortar and concrete.

Testing Standards :**A. Chemical Analysis :-**

Sampling : Test shall be carried out only once for one particular source.

Results :

- a) TDS - 3000 mg/lit. e) Carbonic contents - 200 mg/lit.
- b) Sulphates - 5000 mg/lit. f) Non-carbonic contents - 3000 mg/lit.
- c) pH values - 6 to 8
- d) Chlorides
 - P.P.C - 2000 mg/lit.
 - R.C.C - 1000 mg/lit.

M-2 Lime :

- 2.1 Lime shall be hydraulic lime as per IS : 712. Necessary test shall be carried out as per IS : 6932 (Parts I to X) .
- 2.2 The following fields tests for limes are to be carried out:
- (1) A very rough idea can be formed about the type of lime by its visual examination i.e. fat lime bears pure white colour, lime in form of Porous lumps of dirty white colour indicates quick lime, and solid lumps are the unburnt lime stone.
 - (2) Acid test for determining the carbonate contents in lime. Excessive amount of impurities and rough determination of class of lime.

2.3 Storage shall comply with IS : 712. The slaked lime, if stored, shall be kept in a weather proof and damp-proof shed with impervious floor and sides to protect it against rain, moisture, weather and extraneous materials mixing with it. All lime that has been damaged in any way shall be rejected and all rejected materials shall be removed from site of work.

2.4 Field testing shall be done according to IS : 1624 to show the acceptability of materials.

M-3 Cement :

3.1 Cement shall be ordinary Portland slag cement, grade 33, as per IS : 269, grade 43, as per IS : 8112 and grade 53, as per IS : 12269 or Portland slag cement as per IS : 455.

Testing Standards :

A. Setting time :

Sampling :

(i) From a lot of 50 tones of cement, 2% of bags shall be picked out at random, from which one sample of 15 kg. shall be taken.

(ii) For a lot of 50 to 100 tones - 2 samples

(iii) For a lot of 100 to 200 tones - 3 samples

(iv) For a lot of 100 to 200 tones - 3 samples

(v) For a lot of 200 to 300 tones - 4 samples

(vi) For a lot of 300 to 500 tones - 5 samples

(vii) For a lot of 500 to 800 tones - 6 samples

(viii) For a lot of 800 to 1300 tones - 7 samples

Results:

(a) Initial setting time - not less than 30 minutes

(b) Final setting time - not more than 100 minutes

B. Fineness test by Sieving:

Sampling:

Using any 5 samples, made as above, one test is carried out, using IS sieve no. 90 microns.

Results:

90% or more should pass through the above mentioned IS sieve.

C. Fineness test by determination of specific surface :

Sampling :

Using any 5 samples, made as above, one test is carried out.

Results :

For O.P.C, the surface area shall be $225 \text{ cm}^2/\text{gm}$. or more.

For P.P.C, the surface area shall be $3000 \text{ cm}^2/\text{gm}$.

D. Consistency test :

Sampling :

Sampling shall be as in A.

Results :

Consistency in all samples shall be about 30%.

E. Compressive strength :

Sampling :

Sampling shall be as in A.

Results :

On 2nd day, compressive strength must be 160 Kg/cm²., for O.P.C
 On 7th day, compressive strength must be 220 Kg/cm²., for O.P.C
 On 28th day, compressive strength must be 310 Kg/cm²., for O.P.C

- F. Chemical composition (IS : 4032):
 Sampling :
 Using any 5 samples, made as above, one test is carried out.
 Results :
 a. Magnesium oxide - less than 6%.
 b. Sulphur as Sulphuric anhydride - less than 2.75%.
 c. Loss on ignition - upto 5%.
 The above is for ordinary Portland cement.

M-3A Rapid Hardening Cement (RHC) :

- 3A.1 Rapid hardening cement shall be from source like Gujarat High Tech, Ambuja, Birla or equivalent as approved by the Engineer-in-charge. It shall conform to IS : 8041. Test certificates showing that the cement complies to the specifications must be submitted to the Engineer-in-charge.
- 3A.2 It shall have strength in one day equal to that of OPC in 3 days. It shall be used for products like hume pipes, tiles, sleepers, poles, prestressed and precast concrete members. It shall also be used for foundations, bridges, culverts, causeways etc. where quick construction activity is required however, prior permission of the Engineer-in-charge shall be taken before use.
- 3A.3 It shall capable of giving required workability, final strength and better surface finish.

M-3B Sulphate Resistant Cement (SRC) :

- 3B.1 Sulphate resistant cement shall be from source like Gujarat High Tech or equivalent as approved by the Engineer-in-charge. It shall conform to relevant IS code or BS-4027 & ASTM C-150 Type-II. Test certificates showing that the cement complies to the specifications must be submitted to the Engineer-in-charge.
- 3B.2 It shall be used for structures in or near sea water, where the soil conditions are aggressive, where repeated cycles of drying and wetting are occur, and also for structures which are exposed to Sulphate attack & salty weather like foundations, bridges, dams, tunnels, industrial drains, sewage pipes.
- 3B.3 It should possess low heat of hydration, more compressive strength at 3,7 and 28 days than OPC. It should be capable of withstanding attack of aggressive substances which damage concrete structure like Sulphates of Sodium, Magnesium, Calcium etc. It should have low co-efficient of expansion.

M-4 White Cement :

- 4.1 The white cement shall conform to IS : 8042-E

M-5 Coloured Cement :

- 5.1 Coloured cement shall be with white or grey Portland cement mixed with pigments as specified in the item of the work.
- 5.2 The pigments used for coloured cement shall be of approved quality and its quantity shall not exceed 10% of the cement used in the mix. The mixture of pigment and cement shall be properly ground to have a uniform colour and shade. The pigments shall have such properties as to provide for durability for colour under exposure to sunlight and weather.
- 5.3 The pigment shall have the property such that it is neither affected by the cement nor detrimental to it.

M-6 Sand :

- 6.1 Sand shall be medium/coarse natural sand, clean, well graded, hard, strong, durable and gritty. Sand particles should be free from injurious amounts of dust, clay, kantar nodules, soft or flaky particles of shale, alkali, salts, organic matter loam, mica or other deleterious substances and shall be got approved from the Engineer-in-charge . The sand shall not contain more than 8% of silt as determined by field test and 3% by laboratory test , if necessary the sand shall be washed to make it clean. **All sand to be used for plaster, brickwork , Reinforced concrete work shall be strictly sieved by 4.75 mm sieve.**

Testing Standards :

- A. Silt Content :
Sampling :
Test shall be carried out for every 150 m³ of sand. The sample taken for testing shall weigh 10 Kg.

Results :
Permissible content shall be 3% in laboratory test & 8 % in field Test.

- B. Fineness Modulus :
Sampling :
Sampling shall be as in A.

Results :
Fine sand : 2.2 to 2.6 shall be used as earth filling in plinth, zari, etc.
Medium sand : 2.6 to 2.9 shall be sued for Brickwork and plaster.
Coarse sand : 2.9 to 3.2 shall be used for concrete.

In general, the fineness modulus of sand shall not be less than 2.5 and shall not exceed 3.0. A sand having a fineness modulus more than 3.2 will be unsuitable for making satisfactory concrete.

- C. The sieve analysis of sand shall be as under

IS Sieve Designation	% By weight Passive sieve	IS Sieve Designation	% By Weight passive sieve
4.75 mm	100	600 Micron	30-100
2.36 mm	90-100	300 Micron	5-70

1.18 mm	70-100	150 Micron	0-50
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M-7 Stone Dust :

- 7.1 This shall be obtained from crushing hard black trap or equivalent. It shall not contain more than 8% of silt as determined by field test with measuring cylinder. The method of determining silt contents by fields test is given under:
- 7.2 A sample of stone dust to be tested shall be placed without drying in 200 mm. measuring cylinder. The quantity of the sample shall be such that it fills the cylinder upto 100 mm. mark. Then clean water shall be added upto 150 mm. mark. The mixture shall be stirred vigorously and the contents allowed to settle for 3 hours.
- 7.3 The height of silt visible as settled layer above the stone dust shall be expressed as percentage of the height of the stone dust below. The stone dust containing more than 8% silt shall be washed so as to bring the content within the allowable limit.
- 7.4 The fineness modulus of stone dust shall not be less than 1.80.

M-8 Stone Grit :

- 8.1 Grit shall consist of crushed or broken **hard black trap stone** and be hard, strong, dense, durable clean of proper gradation and free from skin or coating likely to prevent proper adhesion of mortar. Grit shall generally be cubical in shape and as far as possible flaky elongated pieces shall be avoided. It shall generally comply with the provisions of IS : 383 Unless special stone of particular quarries is mentioned, grit shall be obtained from the best black trap or equivalent hard stone as approved by the Engineer-in-charge. The grit shall have no deleterious reaction with cement.
- 8.2 The grit shall conform to the following gradation as per sieve analysis:

IS Sieve Designation	% passing Through sieve	IS Sieve Designation	% Passing Through sieve
12.50 mm.	100%	4.75 mm.	0-20%
10.00 mm.	85-100%	2.36 mm.	0- 5%

- 8.3 The crushing strength of grit will be such so as to allow the concrete in which it is used to build up the specified strength of concrete.
- 8.4 The necessary tests for grit shall be carried out as per the requirements of IS : 2386 (parts I to VIII) , as per instructions of the Engineer-in-charge. The necessity of test will be decided by the Engineer-in-charge .

M-9 Cinder :

9.1 Cinder is well burnt furnace residue which has been fused or centered into lumps of varying sizes.

9.2 Cinder aggregates shall be well burnt furnace residue obtained from **furnace using coal fuel only**. It shall be sound clean and free from clay, dirt ash or other deleterious matter.

9.3 The average grading for cinder aggregates shall be as mentioned below:

IS Sieve Designation	% Passing	IS Designation	% Passing
20 mm.	100	4.75 mm.	70
10 mm.	86	2.36 mm.	52

M-10 Lime mortar :

10.1 Lime shall conform to M-2. Water shall conform to M-1. Sand shall conform to specification M-6.

10.2 Proportion of mix:

10.2.1 Mortar shall consist of such proportions of slaked lime and sand as may be specified in item. The slaked lime and sand shall be measured by volume.

10.3 Proportion of mortar:

10.3.1 Lime mortar shall be prepared by wet process as per IS : 1625. Power driven mill shall be used for preparation of lime mortar. The slaked lime shall be placed in the mill in an even layer and ground for 180 revolutions with a sufficient water. Water shall be added as required during grinding (care being taken not to add more water) that will bring the mixed material to a consistency of stiff paste. Thoroughly wetted sand shall then be added evenly and the mixture ground for another 180 revolutions.

10.4 Storage:

10.4.1 Mortar shall always be kept damp, protected from sun and rain till used up, covering it by tarpaulin or open sheds.

10.5 Use :

10.5.1 All mortar shall be used as soon as possible after grinding. It should be used on the day on which it prepared. But in no case, mortar made earlier than 36 hours shall be permitted for use.

M-11 Cement Mortar :

11.1 Water shall conform to M-1. Cement shall conform to M-3. Sand shall conform to M-6.

11.2 Proportion of Mix:

11.2.1 Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50Kg/Bag of cement being equal to 0.0342 m^3 . The mortar may be hand mixed or machine mixed as directed.

11.3 Proportion of Mortar :

11.3.1 In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry either **mechanically in mixer machine** / manually on a clean impervious platform by turning over atleast 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.

11.3.2 The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

M-12 Stone Coarse Aggregate For Nominal Mix Concrete :

12.1 Coarse aggregate shall be of machine crushed stone of **hard black trap** and be hard, strong, dense, durable, clean and free from skin and coating likely to proper adhesion of mortar.

12.2 The aggregate shall generally be cubical/round in shape. Unless special stones of particular quarries are mentioned aggregates shall be machine crushed from the **hard black trap** or equivalent black hard stone as approved. Aggregate shall have no deleterious reaction with cement. The size of the coarse aggregate for plain cement concrete and ordinary reinforced cement concrete shall generally be as per the table given below. However, in case of reinforced cement concrete, the maximum limit may be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6 mm. less the cover, whichever is smaller.

TABLE

IS Sieve % passing for single size				IS Sieve % passing for single size			
Designation aggregates of Nominal Size				Designation aggregates of Nominal size			
40 mm 20 mm 16 mm				40 mm 20 mm 16mm			
80 mm.	-	-	-	12.5 mm.	-	-	-
63 mm.	100	-	-	10 mm.	0.5	0 - 20	0.30
40 mm.	100	100	-	4.75 mm.	-	0 - 5	0.5
20 mm.	0-20	85-100	100	2.35 mm.	-	-	-
16 mm.	-	-	85-100				

Note : This percentage may be varied some what by the Engineer-in-charge when considered necessary for obtaining better destiny and strength of concrete.

12.3 The grading test shall be taken in the beginning and at the change of source of materials. The necessary tests indicated in IS : 383 and IS : 456 shall have to be carried out to ensure the acceptability. The aggregate shall be stored separately and handled in such a manner as to prevent

the intermixing of different aggregates. If the aggregates are covered with dust they shall be washed with water to make them clean.

Testing Standards :

- A. Flakiness Index :
Sampling :
For every 200 m³. of aggregates, one test shall be carried out.
Results :
The Flakiness index is taken as the total weight of the aggregates passing through the various thickness gauges, expressed as a percentage of the total weight of the sample taken.
Permissible is not more than 35% for aggregates used in concrete for wearing surfaces.
- B. Impact value :
Sampling :
For every 100 m³. of aggregates, one test shall be carried out.
Results :
The impact value shall not be more than 45% by weight for aggregates used for concrete other than wearing surfaces.
For aggregates used for concrete to be used as wearing surface, the impact value shall not be more than 30%, by weight.
- C. Abrasion Value :
Sampling :
Sampling shall be as in B.
Results :
The percentage of wear shall not be more than 35%.

M-13 Black Trap or Equivalent Hard Stone Coarse Aggregates for Design Mix Concrete :

- 13.1 Aggregate for Design Mix Concrete : Coarse aggregate shall be machine crushed stone of black trap or equivalent hard stone and hard, strong, dense, durable, clean and free from skin and coating likely to prevent proper adhesion of mortar.
- 13.2 The aggregates shall generally be cubical in shape. Unless special stones of particular quarried are mentioned, aggregates shall be machine crushed from the best black trap or equivalent hard stones as approved. Aggregates shall have no deleterious reaction with cement.
- 13.3 The necessary tests indicated in IS : 383 and IS : 456 shall have to be carried out to ensure the acceptability of the material.
- 13.4 If the aggregates are covered with dust, they shall be washed with water to make them clean.

M-14 Brick Bats Aggregates :

- 14.1 Brick bat aggregate shall be broken from well burnt or slightly over burnt and dense bricks. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign material. The brick bats shall be less than 40 mm. size, unless otherwise specified in the item. The under-burnt or over-burnt brick bats and brick dust shall not be allowed.
- 14.2 The brick bats shall be hand measured by suitable boxes or as directed.

M-15 Bricks :

- 15.1 The bricks shall be of **first quality** hand or machine moulded and made from suitable soils and kiln burnt. They shall be free from cracks, flaws and modules of free lime. They shall have smooth rectangular faces with sharp corners and shall be of uniform In colour. The bricks shall be moulded with a frog of size 100 mm. x 40 mm., and 10 mm. to 20 mm. deep on one of its flat sides. The bricks shall not break when thrown on the ground from a height of 1 m.
- 15.2 The size of modular bricks shall be 190 mm. x 90 mm. x 90 mm.
- 15.3 The size of the conventional bricks shall be (9"x4.5" x 3") 230 mm. x 110 mm. x 76.5 mm.
- 15.4 Only bricks of one standard size shall be used on a particular work site. The following tolerances shall be permitted in the conventional size adopted in a particular work site.
Length : + 1/8"(3.0 mm.). Width : + 1/6" (1.50 mm.). Height : + 1/6"(1.50 mm.).
- 15.5 The crushing strength of the bricks shall not be less than **50 Kg./cm²**. **No unburned/over burnt bricks** shall be used for any structure. The bricks should have dimensional stability as per IS standards. The average water absorption shall not be more than 20% by weight. Necessary tests for crushing strength and water absorption etc. shall be carried out as per IS : 3495 (Part I to IV) .

Testing Standards :

- A. Efflorescence :
Sampling :
Test of 20 bricks is carried out from a stock of 20,000 bricks.
Results :
Moderate.
- B. Water Absorption :
Sampling :
Test of 32 bricks is carried out from a stock of 35,000 bricks.
Results :
Absorption shall not be more than 20%.
- C. Compressive Strength :
Sampling :
Test of 50 bricks is carried out from a stock of 1,00,000 (1 Lac) bricks.
Results :
On average the compressive strength shall not be less than **50 Kg/cm²**. And every result shall not be less than 20% of the IS standards.

M-15A First Class Bricks for Exposed brickwork :

- 15A.1 First class bricks are those which strictly conform to the standard size of modular bricks, i.e. 19 cm. x 19 cm. x 9 cm. actual size, such that ten layers of brick laid in mortar shall form masonry of 1 m. height. Conventional bricks should have quality standard as per modular brick except size.
- 15A.2 These bricks are manufactured from good quality plastic earth, which is free from saline deposits. They are of good uniform colour. They are well burnt, giving a hard ringing sound when two

bricks are struck together.

15A.3 They should have straight edges and even surfaces. They are free from cracks, chips, flaws and modules of lime.

15A.4 When immersed in water for an hour, they do not absorb water more than 1/6th of their weight. On drying, these bricks do not show any sign of efflorescence.

M-15B Calcium Silicate Bricks :

15B.1 The bricks shall be machine moulded and made from good quality and clean silicious sand, lime and flyash (maximum content upto 30% in raw material composition). They shall be free from cracks, flaws, clay, free lime. They shall have smooth rectangular faces with sharp corners and shall be uniform in size, colour and shape.

15B.2 The size of bricks shall be 228 mm. x 110 mm.x 72 mm. or as approved by the Engineer-in-charge. The compressive strength of bricks shall be minimum 150 kg/m² and the bricks shall have very high strength to weight ratio. The bricks shall have very good resistant capacity to atmospheric conditions, optimum building properties in relation to heat insulation, sound insulation, absorption of water and fire protection.

15B.3 Calcium silicate products shall conform to the appropriate IS standards and there shall be no change required in civil application techniques while using such products in the place of traditional clay bricks.

M-15C Glass Brick :

15C.1 It shall be from Imperial or equivalent as approved by the Engineer-in-Charge.

15C.2 It shall be free from any defects like, cracks, air bubbles, uneven surface, breaks etc. During handling and laying, its edges shall not be damaged. All edges and corners of all faces shall be sharp and well shaped. It shall be of size and colour as specified in the item or as approved by the Engineer-in-charge. The glass bricks shall be of uniform size and tolerance of +2 mm. shall only be allowed in dimensions of glass brick. Spots of colour other than that of bricks or in bricks shall not be allowed. The weight of each brick shall be about 2.75 kg.

15C.3 The transmission of direct light through brick shall not be less than 40%. The glass brick shall have good thermal insulation. It shall be sound proof and vibration absorber having adequate compressive strength. If bricks with groove or projections shall be used, the groove or projections shall be uniform and regular in size & shape.

M-16 Stone :

16.1 The stone shall be of specified variety such as Granite/Trap Stone/Quartz or any other type of good hard stones.

The stones shall be obtained only from the approved quarry and shall be hard, sound, durable and free from defects like cavities, cracks, sand holes, flaws, injurious veins, patches of loose or soft materials etc. and weathered portions and other structural defects or imperfections tending to affect their soundness and strength. The stone with round surface shall not be used. The percentage of water absorption shall not be more than 5% of dry weight, when tested in accordance with IS : 1124. The minimum crushing strength of the stone shall be 200 Kg/cm². unless otherwise specified.

16.2 The samples of the stone to be used shall be got approved before the work is started.

16.3 The Khanki facing stone shall be dressed by chisel as specified in the item for Khanki facing in required shape and size. The face of stone shall be so dressed that the bushing on the exposed face shall not project by more than 40 mm. from the general wall surface and on face to be plastered it shall not project by more than 19 mm. nor shall it have depressions more than 10 mm. from the average wall surface.

M-17 Laterite Stone :

17.1 Laterite stone shall be obtained from the approved quarry. It shall be uniform in texture, sound, durable and free from soft patches. It shall have a minimum crushing strength of 100 Kg./cm². in its dry condition. It shall not absorb water more than 20% of its own weight, when immersed for 24 hours in water. After quarrying, the stone shall be allowed to weather for some time before using in work.

17.2 The stone shall be dressed into regular rectangular blocks so that all faces are free from waviness and unevenness, edges true and square.

17.3 Those type of stones in which white clay occurs should not be used.

17.4 Special corner stone shall be provided where so directed.

M-18 Mild Steel Bars :

18.1 Mild steel bars reinforcement for RCC work shall conform to IS : 432 (Part-II) and shall be of tested quality. It shall also comply with relevant part of latest IS : 456.

18.2 All the reinforcement shall be clean and free from dirt, paint, grease, mill scale or loose or thick rust, at the time of placing.

18.3 For the purpose of payment, the bar shall be measured correct upto 10 mm. length and weight payable worked out at the rate specified below :

1. 6 mm.	0.22 Kg/m.	8. 20 mm.	2.47 Kg/m.
2. 8 mm.	0.39 Kg/m.	9. 22 mm.	2.98 Kg/m.
3. 10 mm.	0.62 Kg/m.	10. 25 mm.	3.85 Kg/m.
4. 12 mm.	0.89 Kg/m.	11. 28 mm.	4.83 Kg/m.
5. 14 mm.	1.21 Kg/m.	12. 32 mm.	6.31 Kg/m.
6. 16 mm.	1.58 Kg/m.	13. 36 mm.	7.99 Kg/m.
7. 18 mm.	2.00 Kg/m.	14. 40 mm.	9.86 Kg/m.

18.4 Procurement of Steel should be from authorized/approved rolling mills and test certificates should be submitted with each lot.

Testing standards :

Sampling :

For every 40 tones of steel, atleast one test shall be done.

Results :

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Thickness	Ultimate Tensile strength	Chilled state	% Elongation

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0 - 20 mm.	42 Kg/cm ² .	26 Kg/cm ² .	23
20 - 40 mm.	42 Kg/cm ² .	24 Kg/cm ² .	23
40 mm. & more	42 Kg/cm ² .	24 Kg/cm ² .	23

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M-19 A High Yield Strength Steel Deforms Bars :

- 19.A.1 High yield strength steel deformed bars be either cold twisted or hot rolled shall conform to IS : 1739 and IS : 1139 respectively.
- 19.A.2 Other provision and requirements shall conform to M-18 for Mild steel bars.

M-19 B Thermo-mechanically Treated Bars (TMT)

- 19.B.1 TMT bars shall conform to IS: 1786
- 19.B.1 Procurement of Steel should be from authorized dealer and test certificates should be submitted with each lot.

M-19 C Corrosion Resisting Steel (CRS)

- 19.C.1 CRS bars shall conform to IS: 1786
- 19.C.1 Procurement of Steel should be from authorized dealer and test certificates should be submitted with each lot.

M-20 High Tensile Steel Wire :

- 20.1 The high tensile wires for the use in prestressed concrete work shall conform to IS : 2090.
- 20.2 The tensile strength of the high tensile steel bars shall be as specified in the item. In absence of the given strength, the minimum strength shall be taken as per para 6.1 of IS : 1785. Testing shall be done as per IS requirements.
- 20.3 The high tensile steel shall be free from loose mill scale, rust oil, grease, or any other harmful matter. Cleaning of steel bars may be carried out by immersion in solvent solution, wire brushing or passing through a pressure box containing carborundum.
- 20.4 The high tensile wire shall be obtained from manufactures in coil having diameter not less than 350 time the diameter of wire itself, so that wire springs back straight on being uncoiled.

Testing standards :

Sampling :

For every 40 tonnes of steel, atleast one test shall be done.

Results :

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Thickness	Ultimate Tensile strength	Chilled state	% Elongation

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For all sizes	49.5 Kg/cm ² .	42.5 Kg/cm ² .	14.5

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M-21 Mild Steel Binding Wire :

- 21.1 The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 or 18 gauge) diameter and shall conform to IS : 280.
- 21.2 The use of black wire will be permitted for binding reinforcements bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

M-22 Structural Steel :

- 22.1 All structural steel shall conform to IS : 226. The steel shall be well and cleanly rolled to the dimensions and weight specified by the IS, subject to the permissible tolerances as per IS : 1852. The finished materials shall be reasonably free from cracks, surface flaws, laminations, rough and imperfect edges and all other harmful defects mentioned in IS : 229 and shall have a smooth finish. The material shall be free from loose mill scale, rust pits or other defects affecting the strength and durability. River bars shall conform to IS : 1148. The decision of the Engineer-in-charge regarding rejecting any steel section on account of any of the above defects shall be final and binding to the Contractor.
- 22.2 Structural steel shall conform to the following requirements. The mechanical and chemical properties shall be as below :

MECHANICAL COMPOSITION OF STEEL

Steel designation	Class of steel product	Nominal thickness in mm.	Tensile strength in Kg/mm ²
			Yield stress min. Kg/mm ²
			% elongation

ST-42 W &	Plates,	Below 6 mm.	Bend test only shall be required.
ST-42 S	flats,		

	bars.	upto 20 & Vc	42 to 54	26.0	23	
		Over 20 upto Vc 40	42 to 54	24.0	23	
		Below 10	Bend test only shall be required			
		10 upto 20 & Vc	42 to 54	28.0	23	
		Over 20	42 to 54	24.0	23	23
ST-42 O	Plates,	Below 6 sections, flats, Over 6	Bend test only shall be required.			
		Below 10	42 to 54	28.0	23	
			Bend test only shall be required			
		10 & above	42 to 54	28.0	23	

CHEMICAL COMPOSITION OF STEEL

Steel designation	Maximum percentage		
	Carbon	Sulphur	Phosphorous
ST-42 W	0.23	0.06	0.06
ST-42 S	0.25/0.28	0.06	0.06
ST-42 O		0.07	0.07

22.3 The following variety of steel shall be used for structural purposes :

ST-42 S : It shall be used for all types of structure (riveted or bolted), including those subjected to dynamic loading and where fatigue, wide fluctuations of stresses, reversal of stresses and great restraint are involved. It shall be suitable for welded structures, provided that the thickness of the material does not exceed 20 mm.

22.4 When the steel is supplied by the Contractor, test certificate of the manufacture shall be obtained according to IS : 226 and other relevant Indian Standards.

M-23 Galvanised Iron Sheets :

23.1 The galvanised iron sheets shall be from Tata or equivalent of approved zinc coating class , as approved by the Engineer-in-charge. It shall be plain or corrugated, of gauge as specified in item. The GI sheets shall conform to IS : 277. The sheets shall be undamaged in carriage and handling either by rubbing off of zinc coating or otherwise, they shall have clean and bright surface and shall be free from dents, holes, rust or white powdery deposit.

23.2 The width of GI sheet shall be as directed, as per site condition.

M-23.A GI Valleys gutter ridges :

23.A.1 The GI ridge and hips shall be of plain galvanised sheets, class-3, of the thickness, as specified in item. These shall be 600 mm. in width and properly bent up to the shape without damage to the sheets, in process of bending.

23.A.2 Valleys, gutters and flashing shall also be of galvanised sheet, of thickness, as specified in item. Valleys shall be 900 mm. wide overall and flashing shall be 380 mm. wide overall. They shall be bent to the required shape without damage to the sheet in the process of bending.

M-24 Asbestos Cement Sheets :

24.1 Asbestos cement sheets plain, corrugated or semi corrugated and curved shall be from Everest or equivalent, as approved by the Engineer-in-charge. It shall conform to IS : 459. The thickness of the sheet shall be as specified in the item. The sheet shall be free from all defects such as cracks, holes, deformation, chipped edge or otherwise damaged.

24.2 It shall manufactured by reinforcing Asbestos in cement, in such a manner that every fibre is covered with fine particles of cement to ensure maximum strength. It shall be alkali resistance and anti corrosive. It should not break during transportation, handling, laying etc. and should be non- destructible, non-inflammable and non-organic. It shall have high tensile strength and high slenderness ratio.

24.3 The minimum nominal thickness of sheets shall be 6 mm., having covering efficiency of about 90% and weight 1518 kg/cm². The sheet shall be free from all defects such as cracks, holes, deformation, chipped edge or otherwise damaged. The permissible bending stress shall be 130 kg/cm².

24.4 The accessories shall be same thickness that of AC sheets. They shall be suitable for all the types of sheets and locations. They also shall be from approved manufacturer and shall be free from any defects. The fixing of AC sheets and accessories shall conform to IS : 730.

24.5 Ridges & Hips :

24.5.1 Ridges and hips shall be of same thickness as that of AC sheets. The different types of ridges shall be suitable for its corresponding type of sheets and locations.

24.5.2 Other accessories to be used in roof such as flashing piece, caves, filler pieces, valley gutters, north light and ventilator curves, barge boards etc. shall be from standard manufacture and shall be suitable for the different types of sheets and location.

M-25 Mangalore Pattern Roof Tiles:

25.1 The mangalore pattern tiles shall conform to IS : 654 for Class AA or Class A type, as specified in the item. Samples of the tiles to be provided shall be got approved from the Engineer-in-charge. Necessary tests shall be carried out as directed.

M-26 Shuttering:

M-26A Timber/Wooden planking:

26A.1 The shuttering shall be either of wooden planking of 30 mm. minimum thickness with or without steel lining or steel plates stiffened by steel angles. The shuttering shall be supported on battens and beams/ MS channels & MS adjustable spans and props of ballies/MS adjustable props with

adjustable head properly cross braced together with 40 mm NB black MS pipes & right angle or Sewell coupler, so as to make the centering rigid. In place of ballie /MS propps , brick pillar of adequate section built in mud mortar or MS H frames, base plates may be used.

- 26A.2 The form work shall be sufficiently strong and shall have camber, so that it assumes correct shape after deposition of the concrete and shall be able to resist forces caused by vibration, live load of men working over it and other incidental loads associated with it. The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement grout.
- 26A.3 If at any stage of work, during or after placing concrete in the structure, the form work sags or bulges out beyond the required shape of the structure, the concrete shall be removed and work redone with fresh concrete and adequately rigid form work. The complete form work shall be got inspected by and got approved from the Engineer-in-charge, before the reinforcement bars are placed in position.
- 26A.4 As far as possible vertical supports shall be of steel .If wooden ballies are to be used in place of MS propps ,the propps shall consist of ballies having 100 mm. minimum diameter, measured at mid length and 80 mm. at thin end and shall be placed as per design requirement (prior approval shall be taken for using wooden ballies). These shall rest squarely on wooden sole plate 40 mm. thick and minimum bearing area of 0.10 m². laid on sufficiently hard base.
- 26A.5 Double wedges shall further be provided between the sole plate and the wooden propps so as to facilitate tightening and easing of shuttering without jerking the concrete.
- 26A.6 The timber used in shuttering shall not be so dry as to absorb water from concrete and swell or bulge nor so green or wet as to shrink after erection. The timber shall be properly sawn and planned on the sides and surface coming in contact with concrete. Wooden form work with metal sheet lining or steel plates stiffened by steel angles shall be permitted.
- 26A.7 MS clamps ,tie rod- PVC cone spring coil -& bolt assembly shall be used for water retaining & under ground RCC works to hold the forms together and use of nails ,wires and spikes shall be avoided. & for non water retaining / above ground level concrete works , MS through tie rods PVC cones & heavy quality PVC pipes can be used .After concreting work, holes shall be filled with 1: 1 cement sand mortar with bonding agent at no extra cost.
- 26A.8 The surface of timber shuttering that would come on contact with concrete shall be well wetted and coated with soap solution before the concreting is done. Alternatively coat of raw linseed oil or oil of approved manufacture may be applied in place of soap solution. In case of steel shuttering, either soap solution or raw linseed oil or shuttering release agent shall be applied after thoroughly cleaning the surface. Under no circumstances, black or burnt oil shall be permitted.
- 26A.9 The shuttering for beams and slabs shall have camber of 4 mm. per meter (1 in 250) or as directed by Engineer-in-charge, so as to offset the subsequent deflection. For cantilevers, the camber at free end shall be 1/50 of the project length or as directed by the Engineer-in-charge.

M-26B Concrete Shuttering Plywood :

- 26B.1 It shall be made from strong and selected hard-woods. It shall be bonded with high quality Phenol Formaldehyde synthetic resin adhesive, hot pressed and then shall be further treated with a permanent type of preservative by vacuum-cum-pressure impregnation.

- 26B.2 Due to the bonding with Phenol Formaldehyde, it shall be moisture and weather proof. The use of selected hard-woods render hard and wear-resistant faces and thereby it shall be reusable several times. It shall be highly resistant to rot, termites and other wood inhabiting insects. Due to complete penetration of the preservative, it shall be exceedingly durable.
- 26B.3 It shall have high impact strength and therefore shall be used successfully in place of timber planks and steel sheets. It shall protect the concrete from rapid temperature changes and shall provide optimum conditions for setting of the concrete. As it shall possess remarkable design flexibility, it shall be ideal for curved formwork.
- 26B.4 Besides it shall be used as centering, shuttering and formwork of concrete columns, beams, slabs, walls, tanks, bridges, fly-overs, silos etc. It shall also be used for structural applications like external walling, roofing, flooring, curtain walls, work-site offices, in cabins of trucks, rail coaches etc.
- M-26C Steel Sheeting and Steel Plates :**
- 26C.1 Steel sheeting and steel plates should be free from clinks, twists, offsets, warps, etc. Their surface should be neat, clean and smooth. Before placing concrete, steel forms shall be thoroughly cleaned off of all rust, dust and loose materials. Colourless oil or grease of approved quality or **approved Mould releasing agents** shall be applied before placing steel.
- 26C.2 The size of angles used for framing and bracing of steel plates should be sufficient to withstand the weight of concrete without forming clinks, twists, offsets, warps, etc. in the welded steel plates. Also, the gauge of steel sheeting used should be minimum 14 G.(2.0mm)
- 26C.3 Minimum two bracing angles should be provided along with angle framing while making the steel plates. It should be riveted or welded to suit the requirement of finish concrete surface. Minimum two rivets should be provided at all Four Corners and at junction of angle framing and bracing.
- 26C.4 If the plates are to be welded, steel sheet and angle framing/bracing should be welded from sides and at back. Welding on sides should be buffed to make the sides smooth. Also, intermittent welding should be done to keep steel sheet and angle framing/bracing in one plane.
- M-27 Expansion Joints-Premoulded Filler :**
- 27.1 The item provides for expansion joints in RCC frame structure, for internal joints as well as exposed joints, with the use of pre moulded bituminous joint filler or Cap cell HD –100 of supreme or equivalent.
- 27.2 Premoulded joint filler, i.e. preformed strip of expansion joint filler shall not get deformed or broken by twisting, bending or other handling pressures, when exposed to atmospheric condition. Pieces of joint filler that have been damaged shall be rejected.
- 27.3 Thickness of the pre-moulded joint filler shall be 25 mm., unless otherwise specified.
- 27.4 Premoulded bituminous joint filler shall conform to BE : 1838.
- M-28 Expansion Joints-Copper Strips & Hold fasts :**

- 28.1 The item provided for expansion joints in RCC frame structure, for internal joint as well as for exposed joints, with the use of necessary copper strip and holdfasts.
- 28.2 Copper sheet shall be 1.25 mm. thick and 125 mm. wide and shall be of 'U' shape, in the middle. Copper strip shall have holdfast of 3 mm. diameter copper rod, fixed to the plate, soldered on the strip at intervals of about 30 cm. or as shown in the drawing or as directed. The width of each flange (horizontal side) of the copper plate, to be embedded in concrete work shall be 25 mm. Depth of 'U' to be provided in the expansion joint, in copper plate shall be 25 mm.
- M-29 Teak Wood :**
- 29.1 The teak wood shall be of superior quality as required for the item to be executed. The kind of wood specifically mentioned as BURMA, MARSOVA, CP, CHILL or SAG teak wood, as approved by the Engineer-in-charge, shall be used. These teakwood, as mentioned above, shall be from specified sources/origins, as approved by the engineer-in-charge.
- 29.2 Teak wood shall generally be free from large, loose, dead or cluster knots, flaws, shades, warps, twists, bends or any other defects. It shall generally be uniform in substance and of straight fibres, as far as possible. It shall be free from knot, decay, harmful fungi and other defects of harmful nature, which will affect the strength, durability and its usefulness for the purpose for which it is required. The colour shall be uniform, as far as possible. Any efforts like painting, using any adhesive or resins materials, made to hide the defects, shall render the pieces liable to rejection by the Engineer-in-charge.
- 29.3 All scantling, planks etc. shall be sawn in straight lines and planes, in the direction of grains and shall be of uniform thickness.
- 29.5 **First class teak wood :**
- 29.5.1 First class teak wood shall have no individual hard and sound knots, more than 6 cm². in size and the aggregate area of such knots shall not be more than 1% of the area of the piece. The timber shall be closed grained.
- 29.6 **Second Class Teak Wood :**
- 29.6.1 No individual hard and sound knots shall be more than 15 cm². in size and the aggregate area of such knots shall not exceed 2% of the area of the piece.
- M-29.A Non-teak wood :**
- 29A.1 The non teak-wood shall be chemically treated, seasoned as per IS specifications and shall be of good quality. The type of wood shall be got approved before collecting the same on site. Fabrication of wooden members shall be started only after the necessary approval.
- 29A.2 For this purpose, wood of Bio, Kalali, Siras, Behda, Jamun, Sisoo will be used for door-frames, where as only Kalali, Siras, Halda, Kalam etc. will be permitted for preparation of shutters, after proper seasoning and chemical treatment.
- 29A.3 The non-teak wood shall be free from large, loose, dead or cluster knots, flows, shakes, warps, bends or any other defect. It shall be uniform in substance and of straight fibres, as far as possible. It shall be free from knots, decay, harmful fungi and other defects of nature which will

effect the strength, durability or its usefulness for the purpose for which it is required. The colour of wood shall be uniform, as far as possible. The scantling, planks etc. shall be sawn in straight lines and planes in the direction of grain and shall be of uniform thickness. The Client will ask the agency to produce certificate from the Forest Department, in event of dispute and the decision of the Client shall be final and binding to the Contractor.

M-29B Processed Rubber Wood :

29B.1 The processed rubber wood shall be like Borotik, Silver teak or equivalent, as approved by the Engineer-in-Charge. It shall conform to IS : 401. The wood shall be made from best quality logs of rubber trees, by treating freshly sawn wood with boron base, timber preservative, as per IS : 401, and drying them uniformly in vacuum, to result into uniform texture and low moisture content wood.

29B.2 It shall be used for manufacturing furniture and furniture components, wall panelling, A.C grills, venetian blinds, wood carvings and handicrafts. It shall be suitably used for production of Door and Window shutters and panels. It shall be available in standard sizes, rough sawn, as listed below :

Length (in Ft.)	Section(W x T, in inches)
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2, 3 and 4	2 x 1, 3 x 1, 4 x 1, 1.5 x 1.5, 2 x 1.5, 3 x 1.5, 4 x 1.5, 2 x 2 3 x 2, 4 x 2, 2.5 x 2.5
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5, 6 and 7	2 x 2, 3 x 2, 4 x 2
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29B.3 The moisture content of the processed rubberwood is 8 to 10% for furniture lengths upto 48 inches, in maximum section 3" x 2". For lengths of 48 to 84 inches, in maximum section 4" x 2.5", the moisture content is 10 to 12%. Its other properties are similar to rubberwood.

1) Density 640 Kg/m ³ .	4) Modulus of elasticity - 9.24 N/mm ² .
2) Hardness : Side - 538 Kg.	5) Shear
End - 627 Kg.	Parallel to grain - 114 Kg/cm.
3) Compression	Perpendicular to grain - 60 Kg/cm.
Parallel to grain - 32 N/mm ² .	6) Shrinkage
Perpendicular to grain - 4.7 N/mm ² .	Radial - 2.6%
	Tangential - 6.1%

29B.4 Processed rubber wood, is easy to re-saw and for planning, boring, turning etc. It is also suitable for lacquering, painting and resin or melamine finish. Gluing or jointing shall be done with PG, UF, RF resins and PVAC glues. Butt joints and edge joints are possible and along with its property of hardness, it is suitable material for parquet flooring, staircase steps, door and window shutters and panel inserts.

M-30 Wooden Flush Door Shutters (Solid Core):

30.1 The solid core type (water proof/ Commercial) flush door shutters shall be of decorative face or non-decorative face type, as specified in the drawing. The size and thickness of the shutter shall be as specified in drawings or as directed. The timber species for core shall be used as per IS : 2202-(Part-I). The timber shall be free from decay and insect attack. Knots and knot holes less than half the width of cross-section of the members in which they occur, may be permitted. Pitch

pockets, pitch streaks and harmless pin holes shall be permissible except in the exposed edges of the core members. The commercial plywood, cross-bands shall conform to IS : 303. And waterproof plywood shall confirmed to IS 710.

30.2 The solid core shall be of wood laminates, prepared from battens of well seasoned chemically treated and treated good quality wood, having straight grains. The battens shall be of uniform size of about 2.5 cm. width. These shall be properly glued) and the block board core. Cross bands and face veneers are bonded together under heat & machine pressed together using BWP type Phenol formaldehyde synthetic resin adhesive, with grains of each piece reversed from that of the adjoining one. The longitudinal joints of the battens shall be staggered and no piece shall be less than 50 cm. in length. Edges of the core shall be

lipped internally with 1st class teak wood battens of 4 cm.(1-1/2") minimum width, glued and machine pressed along with the core.

30.3 The core surface shall then have two or three veneers firmly glued on each face. The first veneer (called cross band) shall be laid with its grains at right angles to those of the core and the second and the third veneers with their grains parallel to those of the core.

30.4 The face panel of the shutters shall be formed by gluing, by the hot press process on both faces of the core with either plywood or cross-bands and face veneers. The lipping, reveting, opening of glazing, venation etc. shall be provided if specified in the drawing.

30.5 All edges of the door shutters shall be square. The shutters shall be free from twist or warp in its plane. Both faces of the shutters shall be sand papered to make smooth even texture.

30.6 The shutters shall be tested for -

- (1) End immersion test : The test shall be carried out as per IS : 2202 (part-I). There shall be no delamination at the end of the test.
- (2) Knife test : The face panel when tested in accordance with IS : 1659 shall pass the test.
- (3) Glue Adhesion test : The flush door shall be tested for glue adhesive test in accordance with IS :2202 (Part-I) . The shutters shall be considered to have passed the test if no delamination occurs in the glue lines in the plywood and if no single delamination more than 80 mm. in length & more than 3 mm. in depth has occurred in the assembly glue lines between the plywood face and the style and rail. Delamination at the corner shall be measured continuously around the corner. Delamination at the knots, knot holes and other permissible wood defects shall not be considered in assessing the sample.

30.7 The tolerance in size of solid core type flush door shall be as under :
In Normal thickness +1.2 mm. In Normal height +3 mm.

30.8 The thickness of the shutters shall be uniform throughout, with a permissible variation of not more than 0.8 mm. when measured at any two points,

M-31 Aluminium Doors, Windows, Ventilators :

31.1 Aluminium alloy used in the manufacture of extruded window sections shall conform to IS designation HEA-WP of IS : 733 and also to IS designation WVG-WP of IS : 1285. The section shall be as specified in the drawing and design. The fabrication shall be done as directed.

31.2 The hinges shall be as approved railway or butt brass nickel plated or SS 304 of kitch or dorma

or equivalent or cast or extruded Aluminium hinge of same type as in window but of larger size.

- 31.3 The hinges shall normally be of 100 mm., openable/projecting type. Non-projecting type of hinges may also be used, if directed. The handles of the door shall be of specified design. A suitable locks for the door, operable either from outside or inside shall be provided. In double shutter door, the first closing shutter shall have concealed aluminium alloy powder coated /Color anodized tower bolt at top and bottom.

M-32 Rolling Shutters :

- 32.1 The rolling shutters shall conform to IS: 6248. Rolling shutters shall be supplied of specified type, with accessories. The size of the rolling shutters shall be as specified in the drawings. The shutters shall be constructed with interlocking lath sections formed from cold rolled steel strips not less than 0.9 mm. thick and 80 mm. wide, for shutters upto 3.5 m. width and not less than 1.25 mm. thick and 80 mm. wide, for shutters 3.5 m. in width and above, unless otherwise specified.
- 32.2 Guide channels shall be of mild steel, deep channel section and roll pressed or built-up (fabricated), with jointless construction. The thickness of the sheet used shall not be less than 3.15 mm.
- 32.3 Hood covers shall be made of MS sheets, not less than 0.90 mm. thick. For shutters having width of 3.5 m. and above, the thickness of MS sheet for the hood cover shall be not less than 1.25 mm.
- 32.4 The spring shall be of best quality and shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions. The spring pipe shaft etc. shall be supported on strong MS or malleable CI brackets. The brackets shall be fixed on or under the lintel as specified with hilti or Fischer
- 32.5 The rolling shutters shall be of self rolling upto 8 m². clear area, without ball bearing and upto 12 m². clear area, with ball bearing. If the rolling shutters are of large area, then gear operated type shutters shall be used.
- 32.6 The locking arrangement shall be provided at the bottom of shutter at both ends. The shutters shall be opened from outside.
- 32.7 The shutters shall be completed with door suspension shafts, locking arrangements, pulling hooks, handles and other accessories.

M-33 Collapsible Steel Gate :

- 33.1 The collapsible steel gate shall be in one or two leaves and size as per approved drawings or as specified. The gate shall be fabricated from best quality mild steel channels, flats etc. and either steel pulleys or ball bearings shall be provided in every double channel, unless otherwise specified. The particulars of collapsible gate shall be as under:
- (a) Pickets: These shall be of 20 mm. MS channels of heavy section, unless otherwise shown on drawings. The distance, center to center of pickets shall be 12 cm. with an opening of 10 cm.
- (b) Pivoted MS flats shall be 20 mm. x 6 mm.
- (c) Top and bottom guides shall be from tee or flat iron of approved size.

(d) The fittings like stoppers, fixing hold fasts, locking cleats, brass handles and cast iron rollers shall be of approved design and size.

M-34 Welded Steel Wire Fabric :

34.1 Welded steel wire fabric for general purpose shall be manufactured from cold drawn steel wire "as drawn" or galvanized steel conforming to IS : 226 with longitudinal and transverse wire securely connected at every intersection by a process of electrical resistance welding and conforming to IS : 4948. It shall be fabricated and finished in workmanlike manner and shall be free from injurious defects and shall be dust proof. The type of mesh shall be oblong or square, as directed. The mesh sizes and sizes of wire for square as well as oblong, welded steel wire fabric shall be as directed. The steel wire fabric in panels shall be in one whole piece, in each panel, as far as stock sizes permit.

M-35 Expanded Metal Sheets:

35.1 The expanded metal sheets shall be free from flaws, joints, broken strands, laminations and other harmful surface defects. Expanded metal steel sheet shall conform to IS : 412 except that blank sheets need not be with guaranteed mechanical properties. The size of the diamond mesh of expanded metal and dimensions of strands (width and thickness) shall be as specified. The tolerance on nominal weight of expanded metal sheets shall be of $\pm 10\%$.

35.2 Expanded metal in panels shall be in one whole piece, in each panel, as far as stock sizes permit. The expanded metal sheets shall be coated with suitable protective coating to prevent corrosion.

M-36 Mild Steel Wire (Wire Gauze Jali) :

36.1 Mild steel wire may be galvanized, as indicated. All finished steel wire shall be well sawn to the dimensions, and the size of the wire shall be as specified in item. The wire shall be sound, free from splits, surface flaw, rough, jagged and imperfect edges and other harmful surface defects and shall conform to IS : 280.

M-37 Plywood :

37.1 The plywood for general purpose shall conform IS : 303.M.R grade(moisture resistant)
Plywood is made by cementing together thin boards or sheets of wood into panels. There are always an odd number of layers, 3,5,7,9 ply etc. The plies are placed so that grain of each layer is at right angles to the grain in the adjacent layer.

37.2 The chief advantages of plywood over a single board of the same thickness is that, plywood offers more uniform strength, along its length and width and also offers greater resistance to cracking and splitting with change in moisture content.

37.3 Usually synthetic resins are used for gluing, phenolic resins are usually cured in a hot press which compresses and simultaneously heats the plies between hot plates, which maintain a temperature of 90°C to 140°C and a pressure of 11 to 14 Kg/cm^2 , on the wood. The time of heating may be anything from 2 to 60 minutes depending upon the thickness.

37.4 When water glues are used the wood absorbs so much water that the finished plywood must be dried carefully. When synthetic resins are used as adhesive, the finished plywood must be exposed to an atmosphere of controlled humidity until the proper amount of moisture has been

absorbed.

37.5 According to IS : 303, the plywood for general purpose shall be of the grades namely BWR, WWR and CWR, depending upon the adhesives used for bonding the veneers, and it will be further classified into six types namely AA, AB, AC, BB, BC and CC based on the quality of the two faces, each face being of three kinds namely, A,B and C. After pressing, the finished plywood should be reconditioned to moisture content not less than 8% and not more than 16%.

37.6 Thickness of plywood boards:

Board	Thickness	Board	Thickness	Board	Thickness	Board	Thickness
3 ply	3 mm.	5 ply	5 mm.	7 ply	9 mm.	9 ply	16 mm.
	4 mm.		6 mm.		13 mm.		19 mm.
	5 mm.		8 mm.		16 mm.	11 ply	19 mm.
	6 mm.		9 mm.	9 ply	13 mm.		22 mm.
							25 mm.

Types of plywood :

M-37A Boiling Water Proof (boiling water Proof) Plywood :

37A.1 The plywood shall be from Kitply, Wonder Wood, Anchor Board or equivalent, as approved by the Engineer-in-charge. It shall conform to IS : 710 and to the relevant Defence and Navy specifications.

37A.2 Plywood shall be made from veneers of hard wood timbers and bonded with high quality BWP type Phenol Formaldehyde Synthetic Resin Adhesive and hot pressed at high temperature and pressure, and further treated with a fixed type of preservative by vacuum-cum-pressure impregnation, to produce thin boards or sheets of wood panels. There are always an odd number of layers. The plies shall be placed, so that, grain of each layer is at right angles to the grain in the adjacent layer.

37A.3 Plywood shall be waterproof, weather proof, boilproof, and highly durable even against strenuous vulnerable uses. It shall resist the attack of termites, cockroaches, wood burrowers, fungus, mould, rot, decay and other wood destroying insects and marine organisms.

37A.4 The tensile strength of the plywood shall be minimum 600 kg/cm². and bending strength above 400 kg/cm². The swelling of plywood in water should be almost negligible. Specific gravity of plywood should be 0.7 to 0.75, having screw and nail holding strength normal to face, atleast 250 kg. and 60 kg., respectively.

37A.5 The moisture content shall be less than 10% and the plywood shall have high fire resistance and shall be free from any cracks, wraps, split etc., and shall have uniform strength all over the panel surface. It shall be used for marine structures, leather tanning tables, wall paneling, and underlayment for kitchen and other furniture, subjected to heat and moisture.

M-37B Commercial Ply :

37B.1 The plywood shall be from Mafatlal Plywood Industries Ltd. or equivalent, as approved by the Engineer-in-charge. It shall conform to IS 303.

37B.2 Plywood shall be made from hard wood timbers, finished with selected species of timber, suitable for veneers and bonded with strictly controlled and evenly spread adhesives.

37B.3 It shall be smooth and strong and shall be free from warping, cupping and twisting.

M-37C Prelaminated - Standard and Veneered :

37C.1 Decorative Plywood :

37C.1.1 It shall be obtained from manufacturer as approved by the Engineer-in-charge. It shall conform to relevant IS Code.

37C.1.2 Plywood shall be made from hard wood timbers, finished with selected species of timber, suitable for veneers and bonded with strictly controlled and evenly spread adhesives. It shall be smooth and strong and shall be free from warping, cupping and twisting.

37C.2 Decorative Veneers :

37C.2.1 Decorative veneered plywood shall be manufactured using veneers of the best quality timbers like Teak, Rosewood, Walnut, Laurel, White Cedar and many others.

37C.2.2 They shall be available in flitch form as well as in lay-on form, in sizes suitable to the furniture industry. They shall be available either flat or quarter sliced, varying in thickness from 0.2 mm. to 1.5 mm. Lengths shall vary upto 4 m.

M-37D Block Boards :

37D.1 They shall be manufactured from well-selected and seasoned hardwood timbers, used in sturdy construction. They shall be usually bonded with Urea Formaldehyde, however against specific requirements to make the termite /porer proof, **Phenol Formaldehyde bonded boards shall be used.**

37D.2 They shall be strong, weather and water proof and shall be ideally used for high quality furniture and exterior applications.

M-38 Glass :

38.1 All glass shall be of the best quality, free from specks, bubbles, smokes, veins, air holes, blisters, and other defects. The kind of glass to be used shall be as mentioned in the item or specification or in the special provisions or as shown in detailed drawings. Thickness of the glass panels shall be uniform. The specifications for different kinds of glass shall be as under:

38.2 Sheet Glass :

38.2.1 In absence of any specified thickness or weight in the item or detailed specifications of the item of work, sheet glass shall be weighing 7.5 Kg/m². for panes upto 600 mm. x 600 mm.

38.2.2 For panes larger than 600 mm. x 600 mm and upto 800 mm. x 800 mm., the glass weighing not less than 8.75 Kg/m². shall be used. For bigger panes upto 900 mm. x 900 mm., glass weighing

not less than 11.25 Kg/m². shall be used.

38.2.3 Sheet glass shall be patent flattened glass of best quality and for glazing and framing purposes shall conform to IS : 1761. Sheet glass of the specified colours shall be used, if so shown on the detailed drawings or so specified for important buildings and for panes with any dimensions over 900 mm., plate glass of specified thickness shall be used.

38.3 Plate Glass :

38.3.1 When plate glass is specified, it shall be 'Polished patent plate glass' of best quality. It shall have both the surface ground flat and parallel and polished to obtain clear undisturbed vision and reflection. The plate glass shall be of thickness mentioned in the item or as shown in the detailed drawing or as specified. In absence of any specified thickness, the thickness of plate glass to be supplied shall be 6 mm. and a tolerance of 0.20 mm. shall be admissible.

38.4 Obscured Glass :

38.4.1 This type of glass transmits light so that vision is partially or almost completely obscured. Glass shall be plain rolled, figure, ribbed or fluted, or frosted, as may be specified or as required. The thickness and type of glass shall be as per details on drawings or as specified or as directed.

38.5 Wired Glass :

38.5.1 Glass shall be with wire netting embedded in a sheet of plate glass. Electrically welded 13 mm. Georgian square mesh shall be used. Thickness of glass shall not be less than 6 mm. Wired glass shall be of the type and thickness as specified.

38.6 Double Glazed units :

38.6.1 Double glazed unit shall comprise of two glasses, of appropriate thickness and absolutely machine-cleaned on both sides, with an air gap of 12 mm .in-between. The space between the two glasses is kept totally dry, avoiding any condensation by sealing the space with elastomeric sealant. Thus in all, it is an insulating glass unit of around 20mm. thickness.

38.6.2 It shall be suitably used for any kind of Doors and Windows, in all areas of work and residences. It shall be absolutely and clearly transparent, giving the following advantages :

- 1) Total light penetration, but with dust and heat insulation.
- 2) Noise insulation.
- 3) 25% saving in electricity due to heat insulation.
- 4) Crystal clear transparency.

M-39 Acrylic Sheets :

39.1 Acrylic sheets shall be of thickness as specified in the item and of specified shape and size, as the case may be. Panels may flat or curved. It should be light in weight. It shall be colourless or coloured or opaque, as specified in the item. Colourless sheet shall be as transparent as the finest optical glass. Its light transmission rate shall be about 95%. Transparency shall not be affected for the sheets of larger thickness. It shall be extremely resistant to sunlight, weather and low temperatures.

39.2 It shall not show any significant yellowing or change in physical properties or loss of light transmission over a longer period of use. The sheet shall be impact resistant also, sheets should be of such quality that they can be cut, bent and jointed, as desired. Solution for the joints shall

be used as per the requirement of manufacturer.

M-40 Particle Board :

- 40.1 The particle board used for face panels shall of best quality free from any defects. The particle boards shall be made with phenolmaldehyde adhesive. The particle boards shall conform to IS : 3087 "Specifications for wood particle board for general purpose". The size and the thickness shall be as indicated.
- 40.2 Particle board shall be made completely from Teakwood and shall be bonded with BWP type Phenol Formaldehyde synthetic resin to give a flat, strong and homogenised panel.
- 40.3 It shall be durable and shall have smooth surface so as to take any type of surface treatment, like polishing, painting, laminating or veneers. It shall be fire resistant, weather resistant, termite and insect resistant. It shall be dimensionally stable, structurally strong and acoustically superior.
- 40.3 It shall be available in all standard sizes as that of the plywood.
- 40.4 Particle board may also be available in veneered form.

M-41 Expanded Polystyrene or Framed Styroper Slabs :

- 41.1 The expanded polystyrene ceiling boards and tiles shall be of approved make and shall be of sizes, thickness, finish and colour, as indicated. They shall be of high density and suitable for use as insulating material. The insulating material shall be like slab of Thermocole etc.

M-42 Resin Bonded Fibre Glass :

- 42.1 The resin bonded fibre glass tiles or rolls shall be of approved make and shall be of sizes, thickness and finish, as indicated.
- 42.2 For test of mineral wool thermal insulation blanket, IS : 3144 shall be followed.
- 42.3 Insulation wool blanket shall be with the following coverings on one or both sides, as indicated.
- (1) Bituminised hessian Kraft paper suitable for use in position where moisture has to be excluded.
 - (2) Hessian cloth or Kraft paper, for keeping out dust.
 - (3) GI wire netting, suitable for surfaces to be plastered over.

M-43 Fixtures and Fastenings :

43.1 General :

- 43.1.1 The fixtures and fastenings, that is butt, hinges, tee and strap hinges, sliding door bolts, tower bolts, door latch, bath-room latch, handles, door stoppers, casement window fasteners, casement stays and ventilators catch shall be made of the metal, as specified in the item or its specification.
- 43.1.2 They shall be of iron, brass, aluminium, chromium plated iron, chromium plated brass, copper oxidised iron, copper oxidised brass or anodised Aluminium, as specified.
- 43.1.3 The fixtures shall be heavy types. The fixtures and fastenings shall be smooth finished and shall be such as will ensure ease of operations.

- 43.1.4 The samples of fixtures and fastenings shall be got approved by Engineer-in-charge, as regards its quality and shape before fixing them in position.
- 43.1.5 Brass and anodised aluminium fixtures and fastenings shall be bright finished.
- 43.2 **Holdfasts :**
- 43.2.1 Holdfasts shall be made from mild steel flat 30 cm. length and one of the holdfasts shall be bent at right angle and two nos. of 6 mm. diameter holes, shall be made in it for fixing it to the frame with screws. At the other end, the holdfast shall be forked and bent at right angles in opposite directions.
- 43.3 **Butt hinges :**
- 43.3.1 Railway standard heavy type butt hinges shall be used when so specified.
- 43.3.2 Tee and strap hinges shall be manufactured from MS Sheet.
- 43.4 **Siding door bolts (Aldrops) :**
- 43.4.1 The aldrops as specified in the item shall be used and shall be got approved.
- 43.5 **Tower bolts (Barrel type) :**
- 43.5.1 Tower bolts as specified in the item shall be used and shall be got approved.
- 43.6 **Door Latch :**
- 43.6.1 The size of door latch shall be taken as the length of latch.
- 43.7 **Bathroom Latch :**
- 43.7.1 Bathroom latch shall be similar to tower bolt.
- 43.8 **Handle :**
- 43.8.1 The size of the handles shall be determined by the inside grip length of the handles. Handles shall have a base plate of length 50 mm. more than the size of the handle.
- 43.9 **Door Stoppers :**
- 43.9.1 Door stoppers shall be either floor door stopper type or door catch types. Floor stopper shall be of overall size as specified and shall have a rubber cushion.
- 43.10 **Door Catch :**
- 43.10.1 Door catch shall be fixed at a height of about 900 mm. from the floor level such that one part of the catch is fitted on the inside of the shutter and the other part is fixed in the wall with necessary wooden plug arrangements for appropriate fixing. The catch shall be fixed 20 mm. inside the face for the door for easy operation of catch.
- 43.11 **Wooden Door Stop with Hinges :**
- 43.11.1 Wooden door stop of size 100 mm. x 60 mm. x 40 mm. shall be fixed on the door frame with a hinge of 75 mm. size and at a height of 900 mm. from the floor level. The wooden door stop shall be provided with 3 coats of oil paint.
- 43.12 **Casement Window Fastener :**
- 43.12.1 Casement window fastener for single leaf window shutter shall be left or right handed as directed.
- 43.13 **Casement Stays (Straight Peg Stay) :**

43.13.1 The stays shall be made from a channel section having three holes at appropriate position so that the window can be opened either fully or partially, as required. Size of the stay shall be 250 mm. to 300 mm., as directed.

43.14 Ventilator Catch :

43.14.1 The pattern and shape of the catch shall be as approved.

43.15 Pivot :

43.15.1 The base and socket plate shall be made from minimum 3 mm. thick plate, and projected pivot shall not be less than 12 mm. in diameter and 12 mm. in length and shall be firmly riveted to the base plate, in case of iron pivot and in single piece base plate, in the case of brass pivot.

M-44 Paints:

M-44A Oil Paints:

44A.1 Oil paints shall be of the specified colour and shade and as approved. The ready mixed paints shall only be used. However, if ready mixed paint of specified shade or tint is not available white ready mixed paint with approved stainer shall be allowed. In such a case, the Contractor shall ensure that the shade of the paint so allowed shall be uniform.

44A.2 All the paints shall meet with the following general requirements:

- (i) Paint shall not show excessive setting in a freshly opened full can and shall easily be redispersed with a paddle to a smooth homogeneous state. The paint shall show no curdling, levering, caking or colour separation and shall be free from lumps and skins.
- (ii) The paint as received shall brush easily, possess good levelling properties and show no running or sagging tendencies.
- (iii) The paint shall not skin within 48 hours in a three quarters filled closed container.
- (iv) The paint shall dry to a smooth uniform finish free from roughness grit, unevenness and other imperfections.

44A.3 Ready mixed paint shall be used exactly as received from the manufacturers and generally according to their instructions and without any admixtures, whatsoever.

M-44B Enamel Paints :

44B.1 The enamel paint shall satisfy all general requirements in specification of oil paints. Enamel paint shall conform to IS : 2933. It shall be from Nerolac, Berger, Asian Paints or equivalent. It shall offer variety of finishes like Glossy, Semi-glossy, Pearl lustre and Matt.

44B.2 It shall be applied either by brush, roll or spray. It shall have a covering capacity of 13 to 18 m². per coat, depending on the surface to be painted. It shall be used both on metal and wood surfaces.

44B.3 It shall have a viscosity of application of 60 to 65 seconds, if brush or rollers are used and 30 to 40 seconds, if spraying is done. It shall have flash point at above 30 ° C. The drying time shall however vary with the ambient temperature and humidity.

M-44C Heritage Wall Finish :

44C.1 It shall be from Bakelite Hylam Ltd. or equivalent, as approved by the Engineer-in-charge. It shall conform to relevant IS Codes. It shall be granules, flakes, granite-flakes and granules and flakes mix.

44C.2 It shall be a two component finish. It shall be easily applicable using trowels and no special tools and training shall be required for application. The single coat application thickness shall be 1.5 mm. thick, of colour and texture, as approved by the Engineer-in-charge. It shall be weather and fade resistant, water and damp resistant, durable and highly washable. It shall be acid and alkali resistant, high abrasion resistant, non-toxic and shall be capable to taking any shape. It can be applied on wide variety of surface like cement mortar, plywood, plaster board, AC sheet, Asbestos board, gypsum plaster or any other materials, to get homogenous layer.

44C.3 It shall be water thinnable to avoid water contamination, incombustible and flexible. It shall be good fire resistant, anti-fungal, good impact resistant having adhesion strength more than 8 kg./cm². There shall not be any development of hair line cracks and no peeling off shall occur, after the maximum drying time of 4 hours and curing period of 2 days.

M-44D Polyurethane Coatings :

44D.1 It shall be from MRF Durodec or equivalent, as approved by the Engineer-in-charge.

44D.2 It shall be a three-coat application, using a brush, spray or a roller. It shall be available in variety of decorative finishes, i.e. in almost all shades and in glossy and matt finishes. It shall offer the following properties :

- 1) Adhesion to concrete surfaces.
- 2) Sealing effect against heavy rain.
- 3) Good water vapour diffusion.
- 4) Weather resistance, colour stability, gloss retention and chalk resistance.
- 5) Resistance to disinfectants, chemical, fire, radiation, acid gases, abrasion and wear.
- 6) Low soil adhesion.

44D.3 It shall be ideal for concrete, floor toppings, on calcium silicate brickwork, glass fibre reinforced concrete, and wood fibre. plaster board, fibre reinforced plasterboard. It shall absorb UV radiation and shall be easily cleaned of radioactive contamination. The ultraviolet part of the solar radiation shall not affect the coating and thereby shall be long lasting.

M-44E Armor Quartz :

44E.1 It shall be from Jenson & Nicholson or equivalent, as approved by the Engineer-in-charge.

44E.2 It is used for exterior surfaces and shall give a thick rich opaque matt finish. It shall be easily applicable using a flat brush well moistened before use. No special tools or training shall be required for application. A single coat application is enough to render a smooth, well prepared surface, in the colour and texture, approved by the Engineer-in-charge. It shall be weather and fade resistant, water and damp resistant, durable. It shall resist fungi and algae. It can be applied on wide variety of surface like cement mortar, plywood, plaster board, AC sheet, Asbestos board, gypsum plaster or any other absorbent material to get homogenous layer. It shall touch dry within 20 minutes and covers 20% more area than other fine textured exterior finishes.

44E.3 It shall be water thinnable, thinned with 5 to 10% of water by volume. It shall require no primer. On a well prepared surface, it shall be applied, in single coat, after one coat of Robbiacem Super cement paint. On a previously painted surface, painted with oil paints, a base coat of Armor Quartz, diluted 1:1 with water is applied before the final coat of Armor Quartz, thinned with 5 to 10% of water by volume. It shall be formulated to last for atleast 10 years.

M-44F Acrylic Emulsion :

- 44F.1 It shall be from Nerolac, Asian Paints, ICI, Berger or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS Codes.
- 44F.2 It shall be used on both interiors and exteriors, on all different types of plaster, wooden surfaces, stone, brickwork, asbestos cement sheets, hard and soft boards, etc. It shall render rich smooth finish and shall provide a tough film that forms a suitable protection against all elements.
- 44F.3 It shall be water thinnable. It shall require no primer. On a well prepared surface, it shall be applied, after one coat of cement primer, in case it is an interior surface and waterproof cement coating, in case it is an exterior surface. On a new but highly absorbent surface, a thin coat of the same shall be applied by adding two parts of water by volume to two parts of Acrylic Emulsion by volume. On previously painted surfaces, one coat of the same shall be applied by thinning four parts of the emulsion with one or two parts of water. It shall be applied by brush, roller or spray. It shall have a covering capacity of 25-30 m²/lit., depending on the surface and shade used. It can be washed to remove the day-to-day dirt, after the surface has been painted, minimum for a month.

M-44G Water Bound Distemper :

- 44G.1 It shall be from Berger, Nerolac, ICI, Asian Paints or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS Codes.
- 44G.2 It shall be available in dry powder form and shall be prepared by adding preferably warm water, in the manner and proportion, as described by the manufacturer. It shall be applied by the conventional distemper brush to all plastered walls, ceilings and woodwork. It shall generally not require any primer, but if found necessary, a size coat made by an experienced painter from glue, soap, warm water and distemper powder shall be applied. It shall offer a covering capacity of 13-16 m² per Kg. depending on the surface and shade used.

M-44H Cement Paints :

- 44H.1 It shall be from Berger, ICI, Asian Paints or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS Codes.
- 44H.2 It shall be manufactured from selected range of raw materials and a special cement, so the it shall be suitable for both indoors and outdoors. It shall be suitably used on concrete renderings, cement/sand renderings, cement/lime/sand renderings, asbestos sheets, fibre boards, brickwork, etc. It shall offer matt finish. It shall require no primer and shall be water thinnable. It shall offer a covering capacity of 6-8 m² per Kg., depending on the surface and shade used. It shall preferably not be applied under direct sunlight to avoid patchy effect.

M-45 French Polish:

- 45.1 The French polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials.
(i) Denatured spirit of approved quality (ii) Chandras (iii) Pigment.
- 45.2 The French polish so prepared shall conform to IS : 348.

M-45A Laquar Polish

- 45A.1 Laquar polish of ASIAN or TARALAC with thinner of same company shall be used. Surfaces to be polished shall be properly grinded with sandpaper and all grains of the wood shall be filled by

sealer coat over that multiple layers of approved company's Laquar to be applied up to hot water resistance.

M-45B Wax Polish :

45B.1 The Wax polish of required tint and shade shall be prepared with the below mentioned ingredients and other necessary materials.

(i) 2 parts Bees wax conforming to IS : 1504-1968 with 1.5 parts boiled linseed oil conforming to IS : 75 and 1 part of Turpentine conforming to IS : 83 and 0.5 part Varnish conforming to IS : 337.

45B.2 Pure bees wax free paraffin or bees adulterants shall be used. The polish shall be prepared from mixture of bees wax, linseed oil, turpentine and varnish in proportion 2 : 1.5 : 1 : 0.5 by weight. The bees wax and boiled linseed oil shall be heated over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warm and turpentine and varnish added to it in the required proportions and entire mixture shall be well stirred.

M-45C Melamine Polish:

45C.1 The melamine polish shall be of best quality and make such as Asian Paints or equivalent, as approved by the Engineer-in-charge. It shall be transparent or opaque, as specified by the Engineer-in-charge.

45C.2 It shall give silken, smooth finish. The Melamine polish shall have shade and shine, either satin or glossy, as approved by the Engineer-in-charge. It shall be two component polish consisting of a base and hardener. It shall be capable of protecting wood from moisture, heat, cold, scratches, stains, cigarette burns etc. It shall have excellent covering capacity. It shall be applicable to all wooden surface of every shape. It shall be applied using brush or spray gun. It shall require lesser time to dry and there shall be no cracks or peeling off of the polish. There shall not be any undulation on the finished surface nor cracks at joints. It shall be of any desired shade as approved by the Engineer-in-charge. It shall have excellent colour, shall be free flowing and shall have good levelling properties. It shall be durable and flexible to absorb cracks. It shall have resistant to scrubs, light rays, heat etc.

M-45D Acrylic Wood Polish:

45D.1 Acrylic wood polish shall be of the best quality and make such as Nebula Chemicals Pvt. Ltd. or equivalent, as approved by the Engineer-in-charge. It shall be made from the best ingredients to give a consistent quality. It shall be water resistant, heat resistant and scratch resistant.

45d.2 It shall offer a silky smooth wood finish. It shall offer any desired shade like rosewood, amber, mahogany, walnut etc. It shall have excellent covering capacity. It shall be applied to all wooden surfaces, of every shape. It shall give a tough and durable surface. It shall require lesser time to dry and shall cover a wider area. On application, it shall form a layer of acrylic which eliminates sanding the surface and therefore helps to reduce time and labour. It shall not require any special equipment to apply.

M-46 Marble Chips for Marble Mosaic Terrazzo :

46.1 The marble chips shall be of approved quality and shades. It shall be hard, sound dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering.

46.2 The size of various colours of marble chips ranging from the smallest upto 20 mm. shall be used where the thickness of top wearing layer is 6 mm. size. The marble chips of approved quality and colours only as per grading as decided by the Engineer-in-charge shall be used for marble mosaic tiles or works.

46.3 The marble chips shall be machines crushed. They shall be free from foreign matter, dust etc., except as above, the chips shall conform to IS : 2114.

M-47 Flooring Tiles :

M-47A Plain Cement Tiles :

47A.1 The plain cement tiles shall be of general purpose type. For these tiles, no pigments are used, in their manufacture. Cement used in the manufacture of the tiles shall be as per IS

47A.2 The tiles shall be manufactured from a mixture of cement and natural aggregates, using pressure process. During the manufacture, the tiles shall be subjected to a pressure of not less than 140 Kg/cm². The proportion of cement to aggregate, in the backing of the tiles shall be not less than 1:3, by weight. The wearing face, though the tiles are of plain cement, shall be provided with stone chips of 1 to 2 mm. size. The proportion of cement to aggregate, in the wearing layer of the tiles shall be three parts of cement to one part chips, by weight. The minimum thickness of wearing layer shall be 3 mm. The colour and texture of the wearing layer shall be uniform throughout its face and thickness. On removal from mould, the tiles shall be kept in moist condition, continuously atleast for 7 days and subsequently, if necessary, for such long period, as would ensure their conformity to requirements of IS : 1237, regarding strength, resistance to wear and water absorption.

47A.3 The wearing face of the tiles shall be plane, free from projections, depressions and cracks and shall be reasonably parallel to the backing of the tile. All angles shall be right angles and all edges shall be sharp and true.

47A.4 The tiles shall generally be square in shape, with a size of 30 cm. x 30 cm. The thickness of the tiles shall be 25 mm.

47A.5 Tolerance of length and breadth shall be ± 1 mm. Tolerance of thickness shall be + 5 mm.

47A.6 The tiles shall satisfy the test as regards transverse strength, resistance to wear and water absorption as per IS : 1237.

Testing Standards :

A. Water Absorption :
Sampling :
6 tiles out of every 3000 tiles are taken for testing.
Results :
Absorption permissible, shall be at the most 10%.

B. Transverse strength test :
Sampling :
12 tiles out of every 3000 tiles are taken for testing.

Results :
When wet :- 80 Kg/cm².
When dry :- 120 Kg/cm².

- C. Abrasion test :
Sampling :
6 tiles out of every 3000 tiles are taken for testing.
Results :
Average abrasion shall not be more than 3.5 mm.

M-47B Plain Coloured Tiles :

- 47B.1 These tiles shall have the same specifications as plain cement tiles, as in 47A above except that they shall have a plain wearing surface, wherein pigments are used. They shall conform to IS : 1237.
- 47B.2 The pigments used for colouring cement shall not exceed 10% by weight of cement used in the mix. The pigments, synthetic or otherwise, used for colouring tiles shall have permanent colour and shall not contain materials detrimental to concrete.
- 47B.3 The colour of the tiles shall be specified in the item or as directed.

M-47C Marble Mosaic Tiles :

- 47C.1 These tiles have the same specifications as plain cement tiles except for the requirements stated below:
- 47C.2 The marble mosaic tiles shall conform to IS : 1237. The wearing face of the tiles shall be mechanically ground and filled. The wearing face of tiles shall be free from projections, depressions and cracks and shall be reasonably parallel to the backing of the tiles. All angles shall be right angles and all edges shall be sharp and true.
- 47C.3 Chips used in the tiles shall be of the smallest size upto 20 mm. size. The minimum thickness of the wearing layer of tiles shall be 6 mm. For pattern of chips required on the wearing face, a few samples with or without their full size photographs, as directed shall be presented to the Engineer-in-charge , for approval.
- 47C.4 Any particular sample, if found suitable shall be approved by the Engineer-in-charge, or he may ask for a few more samples to be presented. The samples shall have to be made by the Contractor till a suitable sample is finally approved for use in the work. The Contractor shall ensure that the tiles supplied for the work shall be in conformity with the approved sample only, in terms of its dimensions, thickness of the backing layer and wearing surface, materials, ingredients, colour shade, chips distribution, etc. required.
- 47C.5 The tiles shall be prepared from cement conforming to IS or coloured Portland cement, generally depending upon the colour of tiles to be used or as directed.

M-47D Chequered Tiles :

- 47D.1 Chequered tiles shall be plain cement tiles or marble mosaic tiles. The former shall have the same specification as per 47A above, and the latter as per marble mosaic tiles as per 47C, except as mentioned below:

47D.2 The tiles shall be of nominal size of 250 mm. x 250 mm. or as specified. The center to center distance of chequer, shall not be less than 25 mm. and not more than 50 mm. The overall thickness of the tile shall be 22 mm.

47D.3 The grooves in the chequers shall be uniform and straight. The depth of the grooves shall not be less than 3 mm. The chequered tiles shall be plain, coloured or mosaic, as specified. The thickness of the upper layer measured from the top of the chequers shall not be less than 6 mm. The tiles shall be given the first grinding, with machine, before delivery to site.

47D.4 Tiles shall conform to IS : 1237.

M-47E Chequered Tiles for Stair Cases :

47E.1 The requirements of these tiles shall be the same as chequered tiles, as per 47D above, except in the following respects:

- (1) The length of a tile including nosing, shall be 330 mm.
- (2) The minimum thickness shall be 28 mm.
- (3) The nosing shall also have the same wearing layer as that at the top.
- (4) The nosing edge shall be rounded.
- (5) The front portion of the tile, for a minimum length of 75 mm. from and including the nosing, shall have grooves running parallel to the nosing and at center not exceeding 25 mm. Beyond that the tiles shall have normal chequer pattern.

M-48 Rough Kotah Stone :

48.1 The kotah stones shall be hard, even, sound and regular in shape and generally be uniform in colour. The colour of the stone shall generally be green. Brown coloured stones shall not be allowed for use. The stones shall be without any soft veins, cracks or flaws.

48.2 The size of the stones to be used for flooring shall be of size 600 mm. x 600 mm. and or size 600 mm. x 450 mm., as directed. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern. Thickness shall be, as specified.

48.3 Tolerance of -30 mm., on accounts of chisel dressing of edges shall be permitted for length as well as breadth. Tolerance in thickness shall be +3 mm.

48.4 The edges of the stones shall be truly chiselled and table rubbed with coarse sand before paving. All angles and edges of the stones shall be true, square and free from chipping and the surface shall be true and plain.

48.5 When machine cut edges are specified, the exposed edges and the edges at joints shall be machine cut. The thickness of the exposed machine cut edges shall be uniform.

M-49 Polished Kotah Stone :

49.1 Polished kotah stone shall have the same specification as Rough kotah stone, except as mentioned below:

49.2 The stones shall have machine polished surface. When brought on site, the stone shall be single polished or double polished, depending upon its use. Single polished kotah stone shall have single face of the stone polished whereas, double polished kotah stone shall have both the faces

polished. The stones for paving shall generally be single polished. The stones to be used for dado, skirting, sink, veneering, sills, steps, etc., where machine polishing after the stones are fixed in situ, is not possible, shall be polished more than once for the desired finish, before fixing.

- 49.3 When brought at site, the colour of the stone shall be fairly uniform. It shall be ensured that the stones to be used in a particular work, shall not differ much in shade or tint, from the approved sample.

M-50 Dholpur Stone :

- 50.1 Dholpur sand stone shall be of best quality, as approved by the Engineer-in-charge. The stone slab shall be without any veins, cracks and flaws. The stone slab shall be even, sound and durable, regular in shape and of uniform colour.
- 50.2 The size of the slab shall be as specified in the item or detailed drawing or as approved by the Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with the permissible tolerance of ± 2 mm.
- 50.3 The stones shall have machine polished surface. When brought on site, the stone shall be rough, single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The stones for paving shall generally be single polished. The stones to be used for sills, steps, brackets, coping, facias, bands, pillars, fabricated railings, jali work etc., where machine polishing after the stones are fixed in situ, is not possible, shall be double polished or polished more than once, as required.
- 50.4 All angles and edges of the stone slab shall be fine chiselled or polished, as specified in the item of work and all the four edges shall be machine cut. All angles and edges of the face of the stone slab shall be true and plane.
- 50.5 The sample of stone shall be got approved by the Engineer-in-charge, for a particular work. It shall be ensured that the stones to be used in a particular work shall not differ much in shade or tint, from the approved sample. No white, black or any other colour spots shall be there. Cheetah or tiger skinned stones shall not be allowed under any case.

M-50A Cobbler Stones (Interlock Pavers) :

- 50A.1 Cobbler stones shall be of best quality, as approved by the Engineer-in-charge and shall be obtained from reliable source. The make will be approved by the Engineer-in-charge and the source of supply shall not be changed without prior approval of the Engineer-in-charge. The stone shall be without any veins, cracks and flaws. The cobbler stones shall be even, sound, durable and regular in shape and of uniform colour.
- 50A.2 The size of the cobbler stone shall be as specified in the items or detailed drawing or as approved by the Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with permissible tolerance of ± 2 mm.
- 50A.3 The stone shall have machine polished surface. When brought on site the stone shall be single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The cobbler stones to be used for walkways, roadways, parking, floors, docks, roofs, public squares etc., where machine polishing after the fixing of stones, is not possible, the stones to be fixed shall be double polished or polished more than once, as required. All angles and edges

of the cobbler stone shall be true and plane.

M-51 Marble Slab :

- 51.1 Marble slab shall be white or of any other available colour and of best quality, as approved by the Engineer-in-charge.
- 51.2 Slabs shall be hard, close, uniform and homogeneous in texture. They shall have even crystalline grain and shall be free from defects and cracks. The surface shall be machine polished to an even and perfect plane surface and edges machine cut, true and square. The rear face shall be rough to provide key for the mortar.
- 51.3 Marble slabs with natural veins, if selected, shall have to be laid as per the pattern given by the Engineer-in-charge. Size of the slab shall be minimum 450 mm. x 450 mm. and preferably 600 mm. x 600 mm. However, smaller sizes will be allowed to be used to the extent of maintaining required pattern.
- 51.4 The slab shall not be thinner than the specified thickness, at its thinnest part. A few specimen of the finished slab to be used, shall be deposited by the Contractor in the office, for reference.
- 51.5 Except as above, the marble slabs shall conform to IS : 1130.

M-51A Blended Marble tile/slab :

- 51A.1 It shall of the best quality like Carara, Marbella or equivalent, as approved by the Engineer-in-charge.
- 51A.2 It shall be predominantly a marble tile/slab, composed of 80% to 95% of finest grains of quality selected marble aggregates, bonded together with 4% to 8% special resins, alongwith palette of colourants. It shall therefore offer a wide range of colour compared to natural marble. It shall be manufactured so, that its design goes right through the tile, insuring lasting designs.
- 51A.3 It shall be available in pre-cut, pre-polished, chamfered and grooved upto sizes of 600 mm. x 600 mm. Sizes upto 2400 mm. x 1200 mm. shall also be supplied. It shall have indispensable mechanical strength,
- | | | |
|--|------|------|
| Test | Dry | Wet |
| Compressive strength in Kg/cm ² . | 1340 | 1317 |
| Flexural strength in Kg/cm ² . | 308 | 453 |
| Modulus of Rupture in Kg/cm ² . | 462 | 453 |
- It shall offer flexibility, high wear resistance, impact resistance and on testing shall be 1.5 kgcm/cm., hardness on the Moh's scale shall be 3 to 4, abrasive wear index shall be 22 and total water absorption shall be around 0.13%. It shall not be easily affected by the freeze and thawing cycling.
- 51A.4 It shall be non-porous and shall be used in all types of weather. It shall be used for internal and external surfaces. It shall be easily cut with a normal hand cutting machine, if required and shall be laid in the same manner as natural marble stone or with latexbased glues.

M-52 Granite Stone :

52.1 Granite shall be of approved colour and quality. It shall be got approved by the Engineer-in-charge, prior to procurement. The stone shall be hard, even, sound and regular in shape and generally uniform in colour. It shall be without any soft veins, cracks or flaws.

52.2 The thickness of the stone shall be as specified in the item.

52.3 All exposed faces shall be double polished to render truly smooth and even reflecting surface. The exposed edges and corners shall be rounded off, as directed. The exposed edges shall be machine cut and shall have uniform thickness.

M-53 PVC / Vinyl Flooring :

53.1 PVC sheets/tiles for PVC/ Vinyl floor covering shall be of the best quality like Wonderfloor, Indag or equivalent, as approved by the Engineer-in-charge. It shall be of homogeneous flexible type, conforming to IS : 3462. The PVC covering shall neither develop any toxic effect while put to use nor shall give off any disagreeable odour.

53.2 Thickness of flexible type covering tiles shall be as specified in the description of the item. The flexible type shall be backed with hessain or other woven fabric. It shall be available in form of tiles, size upto 600 mm. x 600 mm. or rolls of 1.5 m. width, continuous length of 20 m. The thickness shall be approx. 1.5 to 2 mm. The dimensional stability shall be 0.3%. The following tolerance shall be applicable on the nominal dimensions of the rolls or tiles :

(a) Thickness : + 0.15 mm.

(b) Length or Width :

1.300 mm. Square tiles, + 0.20 mm.

3.900 mm. Square tiles, + 0.60 mm

2.600 mm. Square tiles, + 0.40 mm

4 Sheets and roll, + 0.10 %

53.3 It shall offer colour fastness to daylight as per the relevant IS : 3462. Allowance for curling shall be 0.6 mm. It shall be flexible and shall not break, crack or show any signs of failure.

53.4 It shall offer above average resistance to mild and diluted acids, alkalies, soaps and detergents. It shall have high abrasion resistance. At normal temperature, it shall develop an indent of 0.15 mm., after one minute and 0.20 mm., after ten minutes. It shall offer insulation resistance as per the IS : 2259. It shall have a sound reduction factor of 3db for 2 mm. thickness and 2db for 1.5 mm. thickness. It shall have self extinguishing property and water absorption at room temperature for 24 hrs. shall be 0.1%.

53.5 It shall be available in various designs and shall be recommended for floors and walls, in homes, institutions, commercial establishments, clinics and hospitals.

53.6 Adhesive :

53.6.1 The adhesive for PVC flooring shall be of the type and make recommended by the manufacture of PVC sheets/tiles.

M-54 Facing Tiles :

54.1 The facing tiles (burnt clay facing bricks) shall be free from cracks and nodules and of free lime. They shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right angle faces. The texture of the finished surface that will be exposed when in place shall conform to an approved sample consisting not less than four stretcher bricks each

representing the texture desired. The facing tiles shall have a pleasing appearance, sufficient resistance to penetration by rain and greater durability than common bricks. The tiles shall conform to IS : 2691.

54.2 The standard size of facing brick tiles shall be 19 cm. x 9 cm. x 4 cm. The facing brick tiles shall be provided with frog which shall conform to IS : 1077-1976.

54.3 The permissible tolerance in dimensions specified above shall be as follows :

Size	Tolerances for	
	1st Class Brick	2nd Class Brick
19 cm.	+ 6 mm.	+ 10 mm.
9 cm.	+ 3 mm.	+ 7 mm.
4 cm.	+ 1.5 mm	+ 2 mm.

54.4 The tolerance for distortion or warpage of face or edges of individual brick from a plane surface and from a straight line, respectively, shall be as follows :

Facing dimensions	Permissible tolerance
Max. below 19 cm.	Max. 2.5 mm.
- do - above 19 cm.	Max. 3.0 mm.

54.5 The average compressive strength obtained as a sample of five tiles when tested in accordance with the procedure laid in IS : 1077 shall not be less than 175 kg/cm². The average compressive strength of any individual bricks shall be not less than 160 Kg/cm².

54.6 The average water absorption for five bricks tiles shall not exceed 12% of average weight of brick before testing. The absorption for each individual bricks shall not exceed 25%.

54.7 The brick tiles when tested in accordance with IS : 1077, the rate of efflorescence shall not be more than 'Slightly effloresced'.

M-55 White Glazed Tiles :

55.1 The tiles shall be of best quality, as approved by the Engineer-in-charge . They shall be flat and true to shape. They shall be free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

55.2 The tiles shall be nominal size of 150 mm. x 150 mm., unless otherwise specified. The maximum variation from the stated sizes, other than the thickness of tile shall be ± 1.5 mm. The thickness of tile shall be 6 mm. Except for the above, the tiles shall conform to IS : 777.

M-55A Coloured Glaze Tiles :

55A.1 They shall be similar to white glazed tiles mentioned above, in all respects, except that they shall be available in variety of colours and shades, from Johnson & Johnson or equivalent, as approved by the Engineer-in-charge.

M-56 Ceramic Tiles :

- 56.1 Ceramic tiles shall be of 1st quality such as Romano, Regency, Spartek, Stiles or equivalent, as approved by the Engineer-in-charge. They shall adequately meet the relevant IS
- 56.2 They shall be light weight, with thickness varying between 6 to 8 mm., depending on the manufacturer. Therefore, they require thinner floor bedding compared to mosaic/stone flooring. On laying, they require no further polishing making the floor ready to live in and use. They shall be suitably used for residences, offices, hotels, hospitals, auditoriums, restaurants, canteens, commercial complex and such other public places. They shall be extremely strong, breaking strength of the tile being 350 Kg/cm². and flexural strength of 350 Kg/cm². They shall offer good resistance to abrasion, i.e. can withstand upto 5000 grindings. They shall be scratch resistance, their hardness on the Moh's scale shall be 6.8 to 7. They shall be resistant to all acids and alkalis except hydrofluoric acid. In addition, they shall be bacteria free and fire proof, as they are fired at @ 1160⁰C. They shall have very high acoustic damping factor and their specific gravity shall be 0.12, making them good insulators. Their resistance to thermal shocks shall be upto 10 cycles and their co-efficient of linear thermal expansion shall be 9 from ambient temperature to 100⁰C.
- 56.3 They shall be available in various sizes, 8"x4", 8"x8", 8"x12", 12"x12" and 12"x16". They shall have a size tolerance of $\pm 0.4\%$ to 0.75%, in length and width and $\pm 5\%$ in thickness. Allowable warpage shall be $\pm 0.5\%$. Allowable squareness wedging shall be ± 0.4 to 0.5%. The allowable straightness of edges shall be $\pm 0.5\%$ and allowable flatness shall be ± 0.4 to 0.5%. Their water absorption rate shall be less than 5%.
- 56.4 Ceramic tile for Industrial purposes, shall have a hardness of 8.6 on the Moh's scale and shall be non-skid, hard wearing, long lasting and acid and alkali resistant. They shall adequately meet the IS : 4457.

M-57 Vitrified Floor Tiles :

- 57.1 Vitrified floor tiles shall be of best quality like Granamite or equivalent, as approved by the Engineer-in-charge. They shall conform to the relevant IS Codes.
- 57.2 They shall be monolithic and available in smooth, mirror-polished and anti-skid finishes, in sizes 12"x12", 8"x8" and 8"x4". They shall have a size tolerance of $\pm 0.5\%$, in length and width and $\pm 5\%$ in thickness. Allowable warpage shall be $\pm 0.2\%$. Allowable squareness wedging shall be $\pm 0.5\%$. Their water absorption rate shall be less than 0.5%. They shall offer hard-working and hard-wearing floors for homes, public buildings, apartments and airports. The tiles shall be of ASTM or DIN standards.
- 57.3 They shall be extremely strong, breaking strength of the tile being 1600 Kg/cm²., flexural strength, 200 Kg/cm². and bonding strength of 2500 Kg/cm². They shall offer good resistance to abrasion, i.e. greater than 100. They shall be scratch resistance, their hardness on the Moh's scale shall be min. 7. They shall be able to resist thermal shock upto 10 cycles. They shall have a bond strength of 2500 Kg/cm². and shall have a density of greater than 2.2 gm/cc. They shall have 0.60 co-efficient of friction for polished/unpolished surfaces.

M-58 Red Mandana Stone :

- 58.1 Red mandana stone shall be of best quality, as approved by the Engineer-in-charge. The stone shall be without any veins, cracks and flaws. The stone shall be even, sound and durable, regular

in shape and of uniform colour.

- 58.2 The size of the stone shall be as specified in the item or detailed drawing or as approved by the Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with the permissible tolerance of ± 2 mm.
- 58.3 The stones shall have machine polished surface. When brought on site, the stone shall be rough, single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The stones for paving shall generally be single polished.
- 58.4 All angles and edges of the stone shall be fine chiselled or polished, as specified in the item of work and all the four edges shall be machine cut. All angles and edges of the face of the stone shall be true and plane.
- 58.5 The sample of stone shall be got approved by the Engineer-in-charge . It shall be ensured that the stones to be used shall not differ much in shade or tint, from the approved sample.

M-59 Jesalmer Stone :

- 59.1 Jesalmer stone shall be of best quality, as approved by the Engineer-in-charge. The stone shall be without any veins, cracks and flaws. The stone shall be even, sound and durable, regular in shape and of uniform colour.
- 59.2 The size of the shall be as specified in the item or detailed drawing or as approved by the Engineer-in-charge. The thickness of the stone shall be as specified in the item of work, with the permissible tolerance of ± 2 mm.
- 59.3 The stones shall have machine polished surface. When brought on site, the stone shall be rough, single polished or double polished, depending upon its use and as specified in the item or detailed drawing. The stones for paving shall generally be single polished.
- 59.4 All angles and edges of the stone shall be fine chiselled or polished, as specified in the item of work and all the four edges shall be machine cut. All angles and edges of the face of the stone shall be true and plane.
- 59.5 The sample of stone shall be got approved by the Engineer-in-charge, for a particular work. It shall be ensured that the stones to be used in a particular work shall not differ much in shade or tint, from the approved sample. No white, black or any other colour spots shall be there. Cheetah or tiger skinned stones shall not be allowed under any case.

M-60 Shon Tiles :

- 60.1 They shall be of best quality and from manufacturer like Shon Mosaics or equivalent, as approved by the Engineer-in-charge. They shall conform to the relevant IS
- 60.2 They shall be available in the form of sheet pasted on paper for easy fixing. They shall be non-slippery, non-porous, non-sensitive and non-conductive. They shall offer good resistance to temperature changes, chemical effects, impact and pressure and surface abrasion. They shall be weatherproof and 100% fire proof. They shall be light weight and so suitable for cladding on high rise buildings. They shall be available in wide selection of colours and shall be permanent in colour. They shall be stable in form and dimension. They shall be anti-static and easy to clean.

M-61 Sintered Tiles :

- 61.1 Sintered unglazed tiles shall be of the best quality from Kera or equivalent, as approved by the Engineer-in-charge. It shall adequately meet the IS : 4457 specification.
- 61.2 It shall be available in 7 mm., 12 mm. and 20 mm. thickness and shall be used in domestic and industrial applications. It shall be available as heavy duty and acid resistant tiles, as per individual requirement.
- 61.3 It shall have a very high load bearing capacity, with cold crushing strength as 1500 Kg/cm^2 . and shall withstand a load of 3000 Kg/cm^2 . in the compression strength test. The tiles shall have extremely low porosity, because of their monolithic body structure. The water absorption shall be less than 1% and the tiles shall remain free of stains due to lubricants, oils, grease etc. The tiles shall be non-glazed and anti-skid, having a matt finish. They shall be available in special ribbed surface, also. The tiles shall be tough, have high surface hardness, 9 on the Moh's scale and shall offer extremely high resistance to wear and abrasion. They offer good resistance to acids and when tested, the loss of weight shall be around 0.25%.

M-62 Rubber Floorings :

- 62.1 It shall be of the best quality such as Flora or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS specifications.
- 62.2 It shall be available in 6 different colours with special colours supplied on minimum order and in square and round pattern. It shall have a thickness of 2.5 mm., 3 mm., 3.5 mm. and 4 mm. and sizes of 600 mm. x 600 mm. It shall be able to withstand the heaviest traffic and shall have exceptional abrasion resistance, chemical resistance, flame resistance and cigarette burn resistance. It shall have good load bearing capacity, sound deadening characteristics and anti-slip surface. It shall be easy to clean and maintain.
- 62.3 It shall be successfully used in Hospitals, Airports, Computer rooms, Hotels and Restaurants, Laboratories, Office and Shopping complexes, Lifts, Buses, Cinema halls and Residences.

M-63 Admixtures for Tile/Stone Cladding :**M-63A Waterproof Adhesive :**

- 63A.1 Waterproof adhesive, shall be of best quality and from manufacturer like Feb Roffe or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code. It shall be in powdered state, complying with BS : 5980 Type 2, class AA and BS : 5385 Part 1. It shall comprise of selected Portland cements, graded sand and synthetic additives.
- 63A.2 It is useful for permanent adhesion of ceramic tiles, stone and marble cladding to surfaces that may be subjected to extreme weather conditions. It shall provide good tensile adhesion and shear adhesive strength, after application, in thick/thin layer beneath the tile/stone cladding. Its application and coverage shall be as specified by the manufacturer.

M-63B Rainbow Tile Mate :

- 63B.1 Rainbow tile mate, shall be of best quality and from manufacturer like Feb Roffe or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the

Engineer-in-charge. It shall conform to the relevant IS Code.

63B.2 It shall be a special high grade compound, formulated with organic additives and special blend of high grade cement filling compound. It shall be available in various colours to match all types of glazed/ceramic tile. The organic colouring pigment, added in the compound shall not fade over the period of time.

63B.3 There shall be close adhesion of particle in the compound which imparts water-resistant qualities to the compound and allows to render the joints permanently water-tight, i.e. no seepage and no cracking of joints. It shall have strong bonding property so that the joint in the tiling shall never wear out.

M-64 Selected Earth :

64.1 The selected earth shall be that obtained from excavated material or shall have to brought from outside, as indicated in the item. If item does not indicate anything, the selected earth shall have to be brought from outside.

64.2 The selected earth shall be good yellow soil and shall be got approved from the Engineer-in-charge. In no case, Black cotton soil or similar expansive and shrinkable soil shall be used. It shall be clean and free from all rubbish and perishable materials, stones, or brick bats. The clods shall be broken to a size of 50 mm. or less. Contractor shall make his own arrangement, at his own cost, for land for borrowing selected earth. The staking of the material shall be done as directed by Engineer-in-charge, in such a way as not to interfere with any constructional activities and in proper stacks.

64.3 When excavated material is to be used, only selected stuff got approved from the Engineer-in-charge shall be used. It shall be stacked separately and shall comply with all requirements of selected earth mentioned above.

M-65 Barbed Wire :

65.1 The barbed wire shall be of galvanised steel and it shall generally conform to IS : 278. The barbed wire shall be of type-I, whose nominal diameter for line wire, shall be 2.5 mm. and for point wire, shall be 2.24 mm. The nominal distance between two barbs shall be 75 mm., unless otherwise specified in the item. The barbed wire shall be formed by twisting together two line wires, one of them containing the barbs. The size of line and point wires and barbs spacing shall be as specified above. The permissible deviation from the nominal diameter of the line wire and point wire shall not exceed + 0.08 mm.

65.2 The barbs shall carry four points and shall be formed by twisting two point wires, each two turns, lightly round one line wire, making altogether four complete turns. The barbs shall be so finished that the four points are set and locked at right angle to each other. The barbs shall have a length of not less than 13 mm. and not more than 18 mm. The points shall be sharp and cut at an angle not greater than 35° of the axis of the wire, forming the barbs.

65.3 The line and point wires shall be of circular section, free from scale and other defects and shall be uniformly galvanised. The line wire shall be in continuous length and shall not contend any weld other than those in the rod before it is drawn. The distance between two successive splices shall not less than 15 m.

65.4 The length per 100 Kg. of barbed wire, IS type-I, shall be as under :
Nominal 1000 m.

Minimum 934 m.
Maximum 1066 m.

M-66 PVC Waterstops :

- 66.1 The PVC waterstop shall be of approved make, as approved by the Engineer-in-charge.
- 66.2 It shall have optimum resilience, high elasticity & stretch strength, immune to corrosion, excellent weather resistance. They shall be manufactured to safeguard against hydrostatic pressure, water seepage, expansion or contraction of joints and to take care of any deflection or displacement arising due to change in temperature or settlement of foundation to eliminate danger of cracks.
- 66.3 They shall be effective in tropical climate having high mechanical strength, good ageing, longer life, shall be unaffected by acids, alkalies, metal salts and other chemicals. It shall not be hazardous and shall have fire retardant properties. It shall absorb less water than rubber, shall work as water tight seal but shall allow safe passage of seepage water and shall withstand high hydrostatic pressure. It shall be easily welded and can be installed easily, having high tensile strength and shall be capable of bearing heavy shocks arising due to turbines, earthquakes, floods etc.
- 66.4 It shall withstand a minimum hydrostatic pressure of 30 m. high column of water.
- 66.5 The selection criteria of waterstop depends upon the hydrostatic pressure, however the following points should be kept in mind :
- 1) Where substantial expansion/contraction of joints takes place, Dumb Bell type shall be used.
 - 2) Where a firm grip in concrete is desired, Serrated types should be used.
 - 3) The overall width of the waterstop should not be greater than the thickness of concrete.
 - 4) The distance from the face of the concrete to the waterstop must not be less than half the width of the waterstop.
 - 5) The width of the waterstop must be atleast 6 times the largest aggregate used for satisfactory compaction.
- 66.6 The prior approval of selected size and type of waterstop shall be taken from the Engineer-in-charge, before use.

M-67 Admixtures for Mass Concrete and Mortar :

M-67A Joint Sealant :

- 67A.1 The sealant shall be of best quality and from manufacturer like CICO, MC-BAUCHEMIE, PIDILITE, HMP or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code.
- 67A.2 It shall be a two component polysulphide rubber joint sealant, based on a low molecular weight polymer. It should not contain chlorides or other corrosive substances.
- 67A.3 It shall be used for sealing joints in water retaining structures, roofs, external walls, cladding, floors, partitions, ceilings etc. It shall have excellent property to adhere most of building materials like Aluminium, Stainless Steel, Glass, Concrete, Marble, Stone, Brick, Masonry block, Plaster, Ceramic and quarry tiles, Timber etc. The modulus of elasticity of the sealant shall be less than 0.16 MPa, $\pm 10\%$ at 100% elongation. The shore "A" hardness of the sealant shall be

22+3 @ 25°C. The operating temperature range for the sealant shall be -25°C to 800C. The permanent dynamic movement capability of the sealant shall be ±25%. The tensile strength of the sealant shall not be less than 0.4 MPa. The optimum width/depth ratio shall be 2:1. The Sp.gr. of the sealant shall be 1.6 kg/lit. The sealant should be capable to resist attack of water, sunlight, oxidation, corrosive fumes, oils, petrol, diluted acids and alkalis, salt spray, aliphatic and aromatic solvents and shall not contain tar or bituminous ingredients.

67A.4 It shall posses the properties like 550% elongation at break, non-toxicity when fully cured, no staining and shrinkage less than 1%. The trafficable strength shall be achieved within 24 hours and full at 7 days (at 25°C & 250% RH). It shall possess excellent coverage capacity and more strength at low dry temperatures.

M-67B Abrasion Resistant Industrial Flooring Aggregate:

67B.1 The flooring aggregate, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code.

67B.2 The flooring aggregate shall be a factory processed and specially graded non-oxidising, non-magnetic and chemically inert metallic flooring aggregate, free from oil and grease.

67B.3 It shall be used as a surface hardener to concrete floors. It is recommended for Factory floors, Warehouses, Hangers, Car parks and such other areas, subjected to heavy vehicular traffic. It shall also be used on open and continuously wet surfaces. The flooring aggregate shall build in wear resistance and shall produce high abrasion resistant floor surface. It shall impart extreme surface density and shall offer resistance to oil and water penetration. It shall provide a non-rusting floor surface which is easy to maintain.

67B.4 It shall be used with cement in the ratio, as per the manufacturer's instructions and spread evenly on the surface to be treated, at the rate depending on the type of floor. The flooring aggregate shall be spread when the surface of the concrete floor is still fresh, i.e. as soon as the surface water has evaporated and then trowled, in stages, to bring about an uniform and smooth finish.

M-67C Concrete Hardener and Dustproofers :

67C.1 The Concrete hardener and dustproofers, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code.

67C.2 It shall have a specific gravity of 1.18 and shall be applied on concrete floors, at the rate of atleast 25 lit.s per 100 m² per coat. A total of three coats shall be applied for permanently hardened concrete floor, with increased abrasion resistance, increased surface density, increased resistance to chemical attack and to eliminate dust accumulation. Drying time of 4-6 hours for each coat shall be allowed before the floor is put to use or is applied with another coat of the product. Precautions shall be taken while using the product, to avoid contact with eyes and open wounds and to work in good ventilation. After application, the affected parts shall be washed copiously. It shall not be stored for a period of more than 2 months before use.

M-67D Water Repellent Coating :

67D.1 The Water repellent coating, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be

taken from the Engineer-in-charge. It shall conform to the relevant IS Code.

67D.2 Water repellent coatings for exterior exposed surfaces shall be acrylic resin based, having a Flash point of approx. 40°C and specific gravity of 0.95.

67D.3 It shall be suitably used for concrete, brick, stone and plastered surfaces preventing moisture penetration and thus any damage to the interiors. It shall be quick acting, long lasting, invisible i.e. colourless so as to maintain the original colour of the surface treated. It shall impart sealing characteristics so that the treated surface becomes stain and dust free. The coating itself shall not darken or turn yellow with age.

M-67E Accelerating, Water Reducing Admixture and Plasticiser :

67E.1 The Accelerating, Water reducing admixture and plasticiser, shall be of best quality and from manufacturer like CICO or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code.

67E.2 It shall be in liquid state with a specific gravity of 1.30 and complying with ASTM C-494 Type E, IS : 9103 & IS : 2645. It shall accelerate the setting and hardening of the concrete mix, thereby achieving higher early age strength. It shall reduce the water content of the concrete without affecting its workability. It is useful for pre-cast/pre-stressed works, structural concrete works, floors, roads, runways, paving etc. It shall be used at the rate instructed by the manufacturer, with cement, depending on the amount of acceleration of hardening required. It should be compatible to all types of cement.

M-67F Retarding, Water Reducing Admixture and Plasticiser :

67F.1 The Retarding, water reducing admixture and plasticiser, shall be of best quality and from manufacturer like CICO, Feb Roffe or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code.

67F.2 It shall be in liquid state with a specific gravity of 1.22 and complying with ASTM C-494 Type B & D, IS : 9103, CRD-C87 Type B & D, BS 5075 Part 1. It shall be added to the concrete mix during the mixing process, at the same time as the water or the aggregates. No extension of normal mixing time is necessary. It shall extend the period of time as to placing the concrete and compacting, i.e. delay the initial and final setting time. It shall help to spread the heat of hydration over a longer period of time. It shall give a highly workable concrete with a low W/C ratio. It shall be used at the rate instructed by the manufacturer, with cement, depending on the amount of acceleration of hardening required. It should be compatible to all types of cement.

M-67G Water & Weather Proof Compound :

67G.1 The water & weather proof integral cement admixture shall be of best quality and from manufacturer like Feb Roffe's Roff Hyseal, Roff hyproof, Algiproof or equivalent, as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the Engineer-in-charge. It shall conform to the relevant IS Code.

67G.2 It shall be used as an excellent cement admixture in all types of concrete/plaster mortars, pointing mortars, masonry works, guniting works and pressure grouting works. It shall improve resistance of concrete surfaces to weathering and chemical attack. It shall be non-toxic so as to use for

waterproofing water tanks, reservoirs, bio-gas tank, leaking ceiling, basements, tunnels, lift wells etc.

- 67G.3 It shall be mixed to concrete or plaster mortar, while mixing. First, water is added and then the admixture, at the rate instructed by the manufacturer. For use of the admixture, precaution shall be taken to use clean materials for preparation of mortar.

M-67F Plaster Admixture :

- 67F.1 An admixture which gives the plaster workability, durability and quality at an economical rate shall be of best quality from manufacturer like Feb Roffe (product name - Roff plaster master) or equivalent, as approved by the Engineer-in-charge. It shall comply to the relevant IS Codes.

- 67F.2 It shall keep the plastering mortar plastic for a longer time, giving higher strength on prolonged curing. It shall provide cohesiveness, workability and eliminate efflorescence. It shall reduce shrinkage, cracking and crazing to the minimum.

M-68 Asbestos Septic Tank :

- 68.1 It shall be from Everest or equivalent, as approved by the Engineer-in-charge. It shall be of required size as shown in detailed drawing or as per specified in the item. It shall be of single piece in width and length but if required to match the specified size in depth, not more than four compartments shall be allowed (which includes top and bottom pieces and extension pieces). It shall be made from finest raw materials.

- 68.2 It shall be free from any joints in side walls, bottom piece, top cover and baffle walls. It shall be of two compartments separated by a baffle wall in a horizontal section. No leakage should be there from joints between pieces, depth wise. The side walls shall be capable of withstanding the earth pressure and the top cover shall be designed to carry the traffic load and surface covering load.

- 68.3 It shall be air tight and designed to disintegrate the sewage by bacterial action in absence of oxygen gas. It shall contain two inlets (one for regular connection and other for alternative connection) and one outlet. The inlet shall be of 100 mm. dia. and the outlet shall be of 75 mm. dia. All such connection shall be leakproof. Rejected materials shall not be used.

M-69 Asbestos Cement Building Boards:

- 69.1 Asbestos Cement boards shall be from Everest or equivalent, as approved by the Engineer-in-charge. It shall be made from blend of high quality asbestos mineral fibre and cement. It shall conform to IS : 2098, amended 1981.

- 69.2 It shall be light weight, easily workable using ordinary carpentry tools and it shall be strong enough, so as not to be broken or chipped during handling. It shall be durable, flexible, free from rot, rust and shall be termite proof, impervious to weather. It shall not sag, warp, swell or crack and also satisfy the fireproof requirements. The thermal conductivity value 'k' shall be @ 0.214 kcal/hr.m⁰C. It shall have adequate properties of acoustics, having absorption co-efficient between 0.01 to 0.14 and noise resistance co-efficient @ 0.03.

- 69.3 It shall be easily jointed using open or butt joint. Its surface shall be easily painted. It shall be of uniform thickness, as specified in detailed drawings or as approved by the Engineer-in-charge.

M-70 Expanded Polystyrene :

- 70.1 The Expanded Polystyrene shall be from Thermocole, Cooline or equivalent, as approved by the Engineer-in-charge.
- 70.2 It shall be processed from styropor expandable polystyrene beads. It shall have lower thermal conductivity, excellent shock absorption, better mechanical strength and high resistance to the moisture. It shall possess good acoustic properties, snow white appearance, and lightness. It shall easily be cut to any shape, size and can be fixed by any mechanical means or adhesives. It shall be painted easily.
- 70.3 It shall have high, dynamic load bearing capacity, excellent resistance to water vapour. The density of Polystyrene shall be 20-25 kg/m³, having thermal conductivity value 0.025 Kcal/hr m⁰C. The service temperature range shall be -150⁰C to +80⁰C. When soaked in water for 7 days, it shall not absorb water more than 2% by volume. The co-efficient of resistance to water vapour diffusion shall be 40 to 100.

- 70.4 The compressive strength at 10% deformation and cross breaking strength shall not be less than 1.0 kg/cm² and 1.6 kg/cm² respectively. It shall have resistance to soaps, bleaching agents, dilute acids, alkalies, silicone oil, fresh & sea water, alcohol, liquid paraffin, petroleum jelly etc.

M-71 Phenotherm :

- 71.1 Phenotherm shall be from Bakelite Hylam or equivalent, as approved by the Engineer-in-charge. It shall conform to BS : 4370 and BS : 3927, wherever applicable.
- 71.2 It shall have superior fire resistance and thermal conductivity. There shall be no deterioration of K value on ageing, no emission of toxic fumes in an event of fire. It shall have good adhesion to facings and there shall be no shrinkage. It shall conform to the highest fire rating, Class 'I' for surface spread of flame, Class 'P' for ignitability and Class 'O' for building regulations.
- 71.3 It shall not be flammable and shall retain its shape, during and after fire. It shall generate negligible smoke, so the obscuration shall remain less than 5% and shall emit non-toxic fumes during fire. It shall have K value less than 0.016 Kcal/hr m⁰C and the working range of temperature shall be -196⁰C to +130⁰C. It shall easily be used on LSHS, fuel oil, low pressure steam and hot water lines for containers.
- 71.4 It shall have the closed cell content not less than 90% to result in very low water absorption, very low water vapour transmission and reduce condensation. It shall be unaffected by most aromatic and aliphatic solvents. It shall be odourless, non-colour absorbent. It shall not attract rodents/insects, resist fungal and bacterial growth, most organic solvents and chemicals. It shall be anti-corrosive, non-abrasive and hydrophobic. It shall possess good acoustical properties and electrical insulation. The density of the Phenotherm shall be 40-50 kg/m³.

M-72 Ex-foliated Vermiculite :

- 72.1 The Vermiculite shall be from Bharat Heat Insulating & Refractory Industries or equivalent, as approved by the Engineer-in-charge.
- 72.2 It shall be hydrated laminar natural mineral having, Aluminium-Iron, Magnesium Silicates as content and shall consist of thin flat flakes, containing innumerable microscopic voids and layers. It shall have physical properties like chemical inertness, light weight, fire and rot proofness, porosity, non-abrasive nature, flakiness etc.

72.3 It shall have sintering temperature and melting point about 2300°F and 2400°F, respectively. The specific heat and specific gravity of minerals shall be 0.2 and 2.6, respectively. The mineral should possess pH value of 7.0 and cation exchange rate 90 to 100 milli equivalent per 100 grams. The thermal conductivity K shall be 0.43-0.45 Btu.

72.4 The mineral should be incombustible and capable to withstand temperature upto 1100°C to give effective insulation. It shall be insoluble and inert to organic solvents having cold crushing strength atleast 250 Psi. The air contraction at maximum service temperature shall be less than 1%.

M-73 Cement Concrete Hollow Blocks :

73.1 Hollow concrete blocks shall be of size such that they can be bonded with brick masonry, if necessary. The blocks are generally referred by their nominal sizes which include the block and an allowance for joints. The nominal sizes are

- a) 39 x 30 x 19 cm.
- b) 39 x 20 x 19 cm.
- c) 39 x 10 x 19 cm.

The block shall have one or more large holes or cavities which either pass through the block or do not effectively pass through (in case of closed cavity) and shall have the total solid material between 50 to 75% of the total volume of the block, calculated from the overall dimensions. In case of solid blocks, the solid material shall not be less than 75% of the total volume of the block.

73.2 The shell thickness of the blocks shall be not less than 65 mm., in any part, however based on the strength requirements, the thickness can be varied between 20 mm. to 50 mm., as follows :

Nominal block face width.	Shell thickness minimum.	Web thickness minimum.
100 or less	25	25
Over 100 to 150	25	25
Over 150 to 200	30	25
Over 200	35	30

All the above dimensions are in mm.

73.3 The volume of concrete shall not be less than half the gross volume of the block. The total width of the cavities shall not be less than 2/3rd of the overall thickness of the block. The maximum variation in the length of the blocks shall not be more than ± 5 mm. and maximum variation in height and width shall not be more than ± 3 mm.

73.3 Hollow blocks are manufactured by special machines. Casting is done in a single operation. Concrete shall be thoroughly compacted in the moulds with blunt end steel rods or vibrators or by using vibrating tables. Ordinary concrete mix 1:2:4 of very low water/cement ratio is used and shall be mixed as described in the section no. 2.00 of plain and reinforced concrete. Additives or admixtures shall be used such as a) Accelerating, water-reducing and air-entraining admixtures, b) Water-proofing agents, etc. High compressive strength and very dry consistency enables to remove the blocks for curing, immediately after casting. In case of manual compaction, the mixture shall be placed into the mould, in layers of about 50 to 75 mm. and each layer is thoroughly tamped until the whole mould is filled up and struck off level with a trowel. In case of mechanical compaction, the mould shall be filled up to overflow, vibrated or mechanically

tamped and struck off level. Steel wire may be embedded in each block while casting. Rapid hardening cement may be used. After demoulding, the blocks shall be protected until they are sufficiently hardened to permit handling without damage. The blocks shall be thoroughly cured for atleast 14 days and shall be dried out for a period of 4 weeks, before placing. They shall be stacked with voids horizontal to facilitate thorough passage of air. The blocks shall be allowed to complete their initial shrinkage before placing. Water absorption shall not be more than 10% by mass.

73.4 Hollow blocks have better thermal properties than solid blocks. Further hollow blocks made from light weight concrete have still better insulation against heat. They shall conform to the following three grades:

Grade A - They shall be used as load bearing units and shall have a min. block density of 1500 Kg/m³. They shall possess min. average compressive strength of 35, 45, 55 and 70 Kg/cm². respectively, for its sub-category, at 28 days.

Grade B - They shall be used as load bearing units and shall have block density less than 1500 Kg/m³. but not less than 1000 Kg/m³. They shall possess min. average compressive strength of 20, 30 and 50 Kg/cm². respectively, for its sub-category, at 28 days.

Grade C - They shall be used as non-load bearing units and shall have block density less than 1500 Kg/m³. but not less than 1000 Kg/m³. They shall possess min. average compressive strength of 15 Kg/cm². at 28 days.

Grade D - Solid Concrete Blocks - They shall be used as load bearing units and shall have block density not less than 1800 Kg/m³. They shall possess min. average compressive strength of 40 and 50 Kg/cm². respectively, for its sub-category, at 28 days.

73.5 They shall have a variety of surface textures ranging from very fine close texture to a coarse open texture, by proper selection, grading and proportioning of the aggregates. Further the texture shall be developed by treating the surface while the units are still green. Colour shall be rendered by adding non-fading mineral pigments.

73.6 Well made units shall not require plaster, in case of unimportant buildings. Two or three coats of cement paint shall be sufficient to render the masonry resistant to rain water. However, if plaster is intended, the unit shall have a sufficiently rough surface to afford good key to the plaster. Water-proofing admixtures shall be used in the plaster.

M-74 Silicone paint :

74.1 It shall be of the best quality, like Hydroseal - Siliconate Epoxy or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS Codes.

74.2 It shall be prepared by mixing Silicone and Epoxy. It shall be applied on dry as well as damp surfaces. It shall be non-toxic and odourless, so shall be suitable for drinking water structures also. It shall render the surface impervious to water and shall prevent water penetration. It itself shall penetrate into the structure and shall form a strong film on the pores of the structure surface, making the surface water-tight, non-toxic and erosion free.

74.3 It shall be water thinnable. Before use, the hardener of the Siliconate Epoxy shall be mixed with resin and thinned with water, in the proportions described by the manufacturer. It shall be applied with a suitable spray gun with a fine nozzle. An overlap of 25 to 30 cm. shall be preferred. It shall be semitransparent but on drying it shall become transparent.

M-75 Curved Corrugated Asbestos Cement Sheets :

- 75.1 It shall be of the best quality such as Everest or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS specifications.
- 75.2 It shall be available in nominal thickness of 6 mm. with an overall width of 1050 mm. and laid width of 876 mm. It shall be available in standard lengths of 2743 mm. and 3048 mm. It shall have a nominal radius of 2743 mm.
- 75.3 It shall provide an arch roofing system of which the semi-circular arch shall be the most stable. It shall provide a self-supporting roof construction and shall be used for wide varieties of structures for agricultural, industrial and domestic uses, garages and for temporary site offices and for storage of implements. It shall be easily erected without any need of expertise and as temporary sheds without any foundation requirements.

M-76 Red Mud Plastic (RMP) Sheet :

- 76.1 RMP sheet shall be of Regal, Elephant, Rita or equivalent, as approved by the Engineer-in-charge.
- 76.2 It shall not be hazardous to health. It shall have minimum thickness of 1.0 mm. and minimum tensile strength of 400 kg/cm². It shall have high impact strength and it shall not be easily breakable.
- 76.3 The roofing sheets shall withstand the effects of sun, wind, rain, snow, large temperature variations without any loss of smoothness and lustre. It shall be smoothly & attractively finished and opaque in nature. It should be extremely flexible, so as to be bent at any angle without cracking, stretching or becoming soft.
- 76.4 It shall be durable, free from any cracks and vermite & termite proof. It shall be very light in weight, @ 2.5 kg/m². It shall be easily handled and installed. It shall not break during cutting or drilling.
- 76.5 The roofing sheet shall have good thermal insulation and shall be resistant to heat, acid and alkali. It shall be of uniform colour, as approved by the Engineer-in-charge.

M-77 Polyethylene Sheets :

- 77.1 Polyethylene sheet shall be from Profeel, Ramplast or equivalent, as approved by the Engineer-in-charge.
- 77.2 It shall be produced by using a continuous, smooth chemical process, at constant pressure and temperature. The Polyethylene sheets should be light weight, soft, smooth and flexible, which can be easily handled and laid. It shall be 100% water proof, acid proof, alkali proof, fire resistant and fully opaque.
- 77.3 It shall be resistant to fungus, moth, toxic gases and agents having affinity to water. It shall have excellent bonding strength and thermal conductivity shall be 0.023 kcal/m hr⁰C. It shall conform to IS : 5913 and IS : 3792, wherever applicable. It shall prevent corrosion, chemical action, leakage, seepage, pollution.

M-78 Aluminum Corrugated Building Sheets :

- 78.1 It shall be of the best quality and from reputed manufacturer like Indal or equivalent, as approved by the Engineer-in-charge. It shall conform to IS : 1254, in all respects. The aluminium alloys used in the manufacture of the sheets shall conform to IS : 737.
- 78.2 The sheets shall be light in weight, having a density of about 2.70 gms/cm³. Due to the formation of a thin transparent hard film of inert aluminium oxide, on the surface of the sheet, it shall possess high corrosion resistance. The sheets shall be non-fragile and shall be exceptionally durable. As aluminium reflects a high proportion of the radiant heat, the sheets provide excellent insulation when used for cladding/roofing. The sheets shall be non-combustible, non-flammable and non-sparking. As aluminium is elastic, the sheets shall offer high resistance to denting and shall be shatter-proof. Co-efficient of linear expansion of aluminium is 0.000024 per °C and therefore the lateral expansion of the sheets shall be readily accommodated in the corrugations. The sheets shall offer no health hazard and shall be totally hygienic.
- 78.3 It shall be available in trapezoidal and rounded corrugations and shall be extensively used for various Industrial buildings, Warehouses, Aircraft hangers, Power plants, Storage sheds, Bunk houses etc. It shall be innovatively used as interior partitions, wall panels, false ceiling etc.

M-79 Fiber glass Translucent Roofing :

- 79.1 **It shall be of the best quality such as Glass poll or equivalent, as approved by the Engineer-in- charge. It shall conform to BSS : 4154.**
- 79.2 It shall be a combination of glass fibre mat and polyester resin, suitably modified to resist ultraviolet degradation. It shall disperse light rays, allowing uniform diffused light penetration. It shall absorb the heat rays and so helps to save electricity. It shall be available in (1) Clear grade - where light transmission shall be 87% to 90%. and (2) Natural white/green/blue/yellow/red - where light transmission shall be 60% to 70%. It shall be available in lengths of 1.5 m. to 3 m. The width shall be equivalent to that of asbestos/galvanised and aluminium corrugated sheets. It shall have a thickness of 1.2 mm., with a tolerance of ± 0.2 mm.
- 79.3 It shall have a coefficient of linear expansion of .000012 per °C. Its heat distortion temperature shall be approximately 75° C. It shall have thermal conductivity of 0.22 Kcal/mh°C. It shall have an impact strength of 14.5 Ft, hardness of 40 - 50 Barcol and Brinell 26. It shall have a tensile strength of 600 - 800 Kg/cm² and compressive strength of 1200 - 1400 Kg/cm². On soaking for 24 hrs., at 25°C, its water absorption shall be 0.24%. It shall have effective resistance to most chemicals except strong acids.
- 79.4 It shall be suitably used for industrial and residential roof coverings, where light transmission is desired. It shall also be used to cover swimming pools, gardens and terraces, if desired. It shall be normally self cleaning type but when used in industrial areas, it shall be cleaned with water and soap.

M-80

- 80.1 Polycarbonate sheets for versatile glazing shall of the best quality such as Lexan or equivalent, as approved by the Engineer-in-charge. It shall meet all the requirements of BS : 6262. For impact performance, it shall meet the BS : 6206 requirements and for anti-bandit requirements, it shall conform to BS : 5544.

80.2 It shall be as transparent as glass, but shall have half its weight. It shall be tough and yet flexible. It shall have strong impact strength and shall offer thermal and sound insulation. It shall resist the effects of weather, shall be unbreakable and shall provide protection against forced intrusion. It shall be used for roof glazing, door and window glazing as well as privacy glazing, on many different types of buildings. As light weight, it shall be feasible to use it on wider spans. It promotes natural light and shall impart an impression of spaciousness.

80.3 It shall have tensile strength greater than 70 N/mm². Its flexural modulus shall be 2500 N/mm² and flexural yield strength shall be 100 N/mm². It shall have an impact strength (falling dart) greater than 200 Nm. It shall have an indentation hardness - H358 10 of 98 N/mm². and H358 60 of 93 N/mm². Its coefficient of linear expansion shall be 0.00067 per °C and thermal conductivity shall be 0.21 W/m.K. It shall have a specific gravity of 1.2 gm/cc. and water absorption @ 24 hrs. 23°C shall be 10 mg. Its elongation at break shall be greater than 100%. It shall have a higher coefficient of thermal expansion. It shall allow light transmission of between 82% and 90%, depending on the thickness of the sheet. It shall not transmit UV radiation upto 385 Nm. It shall resist the effect of chemicals. It shall have self-extinguishing, low flame spread characteristics and low fire propagation indices.

M-81 Bullet Resistant Laminate :

81.1 It shall be of the best quality such as Lexgard or equivalent, as approved by the Engineer-in-charge.

81.2 It shall be polycarbonate sheet, laminated together using a patented general electric interlayer film with a mar-resistant finish. It shall be bullet-resistant, shall not spall, splinter or crack and shall have a long lasting glazing for surface appearance. It shall be 60% less in weight compared to bullet-proof glass. It shall have a K-value of 3.06 W/m² K for thermal insulation and allow light transmission of 63%, when 33 mm. thick.

81.3 It shall be suitably used in Banks, Police stations, Cash counter etc., wherever there is a risk of deliberate attack.

M-82 Polyester Films :

82.1 It shall of the best quality such as Sun Control Garware or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS specifications.

82.1 It shall reject about 75% of the total solar energy. It shall reduce 97% of the harmful UV radiation. It shall eliminate 80% of the sun glare. It shall make the glass surface shatter resistant when bonded on to glass. It shall be free from all fire hazards. It shall be available in various reflective shades.

M-83 High Molecular Plastic Film :

83.1 The film shall be from Om Agro Industrial Plastics Pvt. Ltd. or equivalent, as approved by the Engineer-in-charge. It shall conform to relevant IS Code.

83.2 It shall be fully impervious to provide a complete water barrier system. The tensile strength of the film shall not be less than 450 kg/cm². The tear resistance of the film shall not be less than 3200 g/100/micron having 650% ultimate elongation. The impact tensile strength and temperature resistance shall not be less than 2000 kg/cm². and 90°C respectively.

83.3 The film shall be flexible having uniform thickness as specified in the respective item. It shall have long life in buried condition. Saline or mineral water and alkali content in soil or cement or most of the chemicals shall have no effect on the film. The film shall discourage weed growth under the lining.

M-84 Gyp board :

84.1 It shall be of the best quality from India Gypsum or equivalent, as approved by the Engineer-in-charge.

84.2 It shall be formed by enclosing and bonding together a core of set gypsum plaster by two sheets of heavy paper. It shall offer high standard of safety, thermal efficiency and aesthetics. It shall be light in weight, shall offer good fire resistance and shall render faster construction. It shall be suitably used in areas subjected to continuously damp or wet conditions, except bathrooms, where gypboard partitions shall be properly protected by tiles or other impervious materials. It shall be a non-resonant material, rendering sound insulation. It shall be strong, durable and dimensionally stable. It shall offer a smooth surface which can be painted, tiled or wall papered. It shall block the passage of heat and shall retard the spread of fire. It shall hide upto 60 db of sound, when erected in the proper manner.

M-85 Ceiling Tiles :

85.1 It shall be of the best quality, such as Gypboard, Sitatex or equivalent, as approved by the Engineer-in-charge. It shall adequately follow the IS : 3129.

85.2 They shall be made either from gypboard or from sugarcane fibres, as specified in the item.

85.3 They shall be resistant to fire, termites, fungus, woodboring, insects and other wood deteriorators. They shall be resistant to delamination due to moisture and cyclic changes in weather and humidity. They shall have high structural strength, good thermal insulation properties, thermal conductivity at mean temperature shall be $4.2 \text{ K.cal/cm.}/\text{m}^2/\text{hr.}/^\circ\text{C}$ and good fire retardant properties. It shall have a density of $288 \text{ Kg/m}^3 \pm 10\%$ and shall weigh 3.71 Kg/m^2 . Whenever, P.F resin shall be used in bonding, good weather and boiling-water proof properties shall be rendered under ISS and BSS specifications. They shall favourably absorb sound, rendering good acoustic properties.

85.4 They shall be available in ready-to-fix, ready-cut standard sizes of 610 mm. x 610 mm. x 12 mm., in various design and plain tiles shall be available in sizes, 2440 mm. x 1220 mm. x 12 mm., 1220 mm. x 1220 mm. x 12 mm., 1220 mm. x 610 mm. x 12 mm. and 610 mm. x 610 mm. x 12 mm. They shall be suitably used in residences, public places, bank buildings, studios, showrooms, computer centres, telecommunication buildings etc.

M-86 Permagard :

86.1 Permagard shall be from India Foils Ltd. or equivalent, as approved by the Engineer-in-charge.

86.2 It shall be made by laminating aluminium foil/strip with polyethylene film on both sides. It shall be a continuous sheet of metal having overlapped and sealed edges, which shall be sealed using a heat sealer or hot molten bitumen. It shall resist the action of water, moisture, salts, chemicals, oxidation and corrosion. It shall be 100% water proof.

86.3 No joints shall be allowed in sheets brought to site. However, the joints required at site shall be sealed using either hot molten bitumen or Teflon coated heat sealer, making an air tight bond, which is totally impervious to water and moisture. The thickness of permagard shall be 0.26 mm. ± 0.03 mm. The weight shall not be less than 0.54 kg/m². It shall have excellent abrasion power.

M-87 Thermolay :

87.1 It shall be from STP Ltd. or equivalent, as approved by the Engineer-in-charge.

87.2 It shall comprise of modified bitumen impregnated reinforcement fabric, sandwiched between coats of polymer modified bitumen, with the underside covered with thermofusible polyethylene film and the topside finished with coarse sand. It shall be available in continuous roll, length 10 m. and width 1 m. The thickness of the membrane shall be 4 mm.

87.3 It shall have a tensile strength of 150 Kg. min. (longitudinal) and 100 Kg. min. (traverse). It shall have good heat resistance and flexibility. It shall be able to take up thermal and structural stresses, without fatigue. It shall offer high resistance to puncture and indentation load. Net weight per roll shall be 50 Kg. It shall act as a water-tight and vapour barrier system, when laid.

M-88 Sliding Door Tracks/Channel :

88.1 It shall be from Agend, Coburn System or equivalent, as approved by the Engineer-in-charge.

88.2 It shall be made with highest quality precision engineering to give the ultimate in smooth, frictionless action and to move the doors silently, at the touch of a finger. It shall carry a load upto 100 lbs., to ensure life time trouble free operation from all components. It shall be in three classifications :

Straight sliding :

When a clear wall space equivalent to the area of one leaf should be available to the right of the opening either inside or outside the opening.

Sliding and Folding, end hung :

Where clearance is restricted, such arrangement is recommended. It shall provide maximum possible free space when folded to the open position.

Sliding and Folding, center hung :

It shall be provided where there is restriction of space. It shall provide smooth running action and unobtrusiveness of fittings. It shall enable the leaves to fit closely between the jambs of the opening.

88.3 All these sliding gears are top hanging with bottom guides. All movements shall be on ball bearing so that friction is reduced to minimum.

Track : It shall be made from sturdy steel with protective zinc coating. The shape of the track shall ensure true, smooth running and prevents door from jumping off. It shall be adjusted horizontally to compensate for minor irregularities in floor level.

Roller Hangers : It shall be made from 16 gauge zinc plated steel, housing containing tough Nylon rollers with exclusive differential movement. No lubrication shall be required. The hanger platter fitted to the top of the doors shall have lateral adjustment feature, to compensate for minor irregularities in surface by positioning the door at slightly varying distances from wall.

End Stops : It shall be made from sturdy zinc plated steel angle, shaped to ensure positive stopping action and prevent door in conjunction with rubber buffers or hangers.

Floor guide : It shall be manufactured from tough nylon, shaped, to allow smooth movement of grooved doors or non-grooved doors.

M-89 Sand Stone Grills/Baluster :

89.1 It shall be from Dilpasand Shilp or equivalent, as approved by the Engineer-in-charge.

89.2 It shall be made from best quality Bansipahadpur/Sandstone, having uniform colour (no other colour spot shall be allowed) and texture. The sand stone shall be even, sound, durable and free from any veins, cracks and flaws. The thickness of the stone used shall be as specified in item of work, with the permissible tolerance of 2 mm.

89.3 The grills/Baluster shall be produced by fine chiselling. All edges, faces and angles of fine hand chiselled grills, columns, baluster shall be machine polished, as specified in item.

M-90 Anti-Corrosive Paints :

M-90A Ferroshield :

90A.1 It shall be from STP Limited or equivalent, as approved by the Engineer-in-charge.

90A.2 It shall be a high build bituminous emulsion, specially formulated for protection against corrosion. It shall form a dry film, 2 mm. thick, which shall not crack at low temperatures nor crocodile at very high temperatures. It shall also be used as waterproofing material on flat, sloped and steeped roofs. It shall be applied by brush and by heavy duty airless spraying.

M-90B Tankmastic :

90B.1 It shall be from STP Limited or equivalent, as approved by the Engineer-in-charge. It shall conform to IS : 158-1982 and IS : 9862.

90.2.2 It shall be special bituminous paint, which shall have no harmful reaction on drinking water. It shall be used to protect the inside of water tanks and pipe connections, against corrosion. It shall be applicable on steel, wood, concrete, iron etc. It shall have a covering capacity of 12 m²/lit..

M-90C Pipekote :

90C.1 It shall be from STP Limited or equivalent, as approved by the Engineer-in-charge. It shall conform to IS : 158.

90C.2 It shall be a heavy duty bituminous paint, which shall not impart any odour or taste to water, carried in the steel water pipelines, tanks and pen-stocks. It shall be applied on the inside surface of the water pipeline, tanks and pen-stocks. It shall be resistant to mild acids, alkalis and shall withstand heat upto 150°C. It shall render a heavy body protective film. If zinc-rich, epoxy primer shall be used, better results of pipekote shall be obtained.

M-90D Silvershield :

90D.1 It shall be from STP Limited or equivalent, as approved by the Engineer-in-charge.

90D.2 It shall be a bituminous aluminium-finish paint formulated for application over anti-corrosive paints. It shall have a covering capacity of 10 m²/lit..

M-90E Shalimastic HD :

90E.1 It shall be from STP Limited or equivalent, as approved by the Engineer-in-charge. It shall comply with the US Dept. of interior bureau of reclamation specification CA-50.

90E.2 It shall be a viscous, heavy-duty, anti-corrosive waterproof coal tar paint. It shall offer resistance to acids and alkalis. It shall be used for protection of all types of iron and steel structures.

M-91 Powder Paints :

91.1 Powder paints shall of superior quality such as Hawcoplast of Hardcastle & Waud Mfg. Co. Ltd. or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS specifications.

91.2 It shall be available in the following types :
Epoxy :
It shall be tough and resistant to chemicals. However, it shall have poor exterior durability.
Epoxy polyester :
It shall provide a decorative finish and shall have better overbake resistance.
Polyester - TGIC :
It shall provide exterior durability but it shall form a slightly thicker film.
Polyurethane :
It shall provide exterior durability and shall form a thin film coating.

M-92 MDF (Medium Density Fibre) Wood :

92.1 The MDF wood shall be from Nuwud or equivalent, as approved by the Engineer-in-charge and shall conform to IS : 12406.

92.2 MDF wood shall be manufactured from wood fibres and synthetic resin binder to produce homogenous sheet material, having minimum density about 600 to 900 kg/m³. It shall have moisture content less than 8% and water absorption less than 12% at 24 hours soaking. It shall have modulus of rupture and tensile strength atleast 50 N/mm² and 0.8 N/mm², respectively.

92.3 The screw withdrawal strength shall be minimum 3000 N. for face and 1800 N. for edge. It should be highly resistant against termite, insects and it should possess good heat and sound insulation. It should be easily workable for moulding, carpentry, routing etc. It should be free from any cracks, wraps, splits etc. and should possess uniform strength in all direction.

M-93 Polyurethane Foam Insulation :

93.1 Polyurethane foam shall be from SDC, FGP, Excilite, VCM or equivalent, as approved by the Engineer-in-charge. It shall conform to the relevant IS Code.

93.2 It shall have high strength to weight ratio alongwith excellent thermal insulation and acoustic absorption. It shall be based on the exothermic, catalytic reaction of polyisocyanates with polyol

molecules containing hydroxyl groups in the presence of blowing agent. It shall be perfectly homogenous and having uniform characteristics like perfect adhesion to metal surfaces, higher insulation capacity, maximum resistance and lightness. It shall be perfect non-hygroscopic, completely water proof having dimensional stability, optimum thermal insulation, fire retardancy.

- 93.3 It shall be of low foam density, not more than 40 Kg/m^3 . The thermal conductivity shall be $0.02 \text{ Kcal/m hr}^\circ \text{C}$. The compressive strength shall not be less than 2.5 Kg/cm^2 and 1.2 Kg/cm^2 , in direction parallel to rise and perpendicular to rise respectively. The close cell content of the foam shall be 90 to 95% and it shall be workable within the temperature range of -150°C to $+80^\circ \text{C}$. The water vapour permeability shall be 2.0 perms/in.

M-94 Fibreglas Reinforced Plastics (FRP):

- 94.1 Fibreglas Reinforced Plastic shall be from CEAT or equivalent, as approved by the Engineer-in-charge. It shall conform to relevant IS Code.
- 94.2 It shall be either unidirectional reinforced or sheet moulded or filament wound epoxy to match the purpose of work and item of tender. It shall have versatile chemical inertness, electrical resistance and mechanical strength, ease of processibility, repeatability and predictability. It shall have desirable characteristics like light weight, high strength, stiffness, toughness, thermal insulation properties, superior weather resistance, complete elasticity, fatigue, creep, resistance to corrosion, rot, swelling, insects, fungus etc.
- 94.4 There shall be no yield point beyond which buckling or denting of the FRP occurs, to reduce the possibility of irritating damages for minor stresses or impacts. The density, flexural strength and flexural modules shall not be less than 1.5 mg/m^3 , 1000 MPa and $40 \times 10^3 \text{ MPa}$, respectively. It shall have minimum tensile strength, tensile modulus and compressive strength of 1000 MPa, $40 \times 10^3 \text{ MPa}$ and 250 MPa, respectively. The FRP shall have thermal conductivity about $0.2 \text{ w/m}^\circ \text{C}$. Thermal coefficient of expansion shall be less than $10 \times 10^{-6} \text{ per } ^\circ \text{K}$.
- 94.5 The minimum glass content shall be 60%. The weight index for stiffness and tensile strength at yield shall not be less than 0.6 and 0.9 respectively. No damage should be there while testing at impact energy of 8 joules. The level of translucency should be greater than 80% of diffused transmission that of direct light. It shall provide superior aesthetic value with incorporated colour. It shall be good fire retardant, durable and impermeable to water.